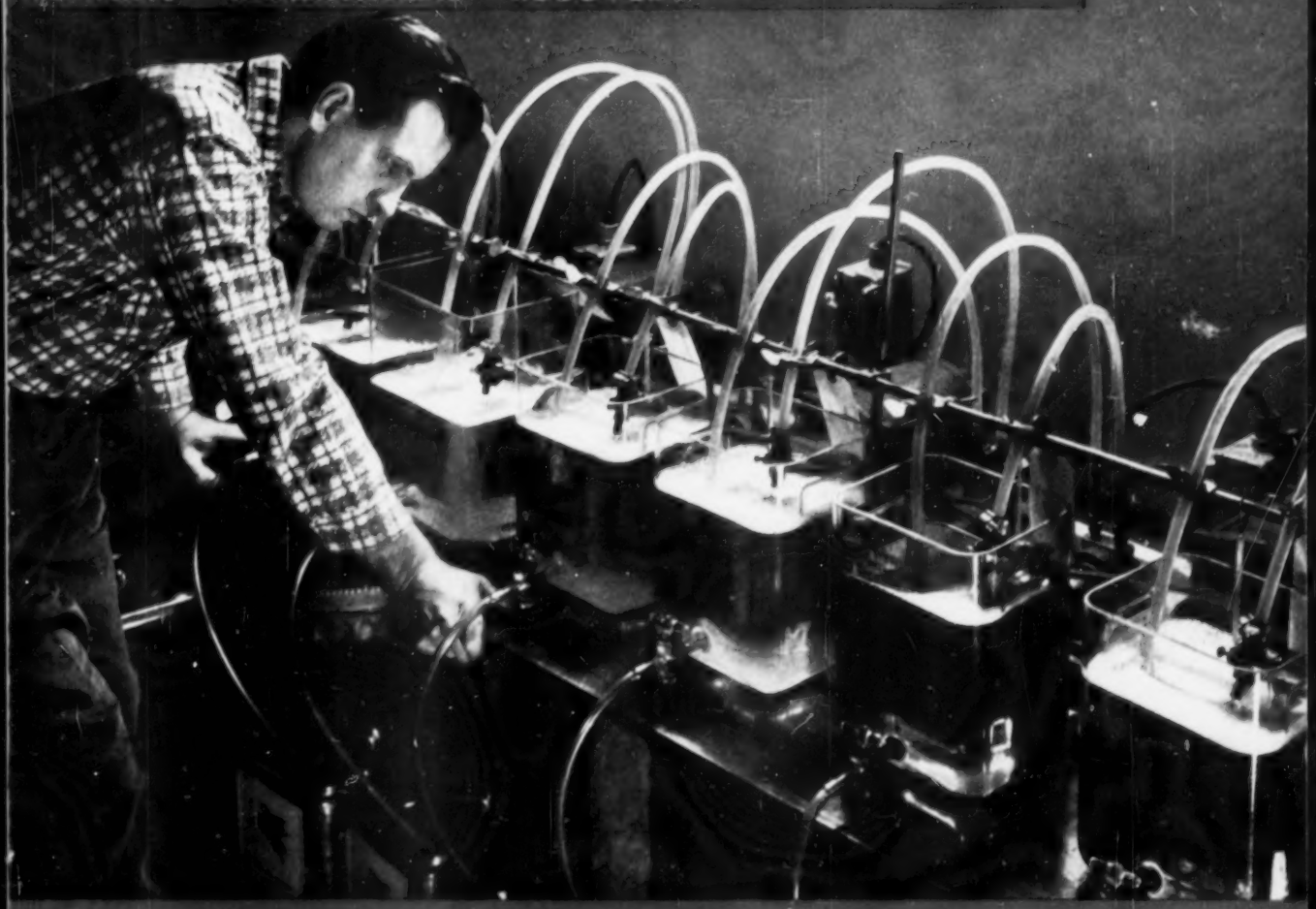
Petroleum Processing

PETROLEUM REFINING | PETROCHEMICAL MANUFACTURING | GAS LIQUIDS RECOVERY

JANUARY, 1956



CHECKING GEL FORMATION—a critical factor in distillate quality—p. 67

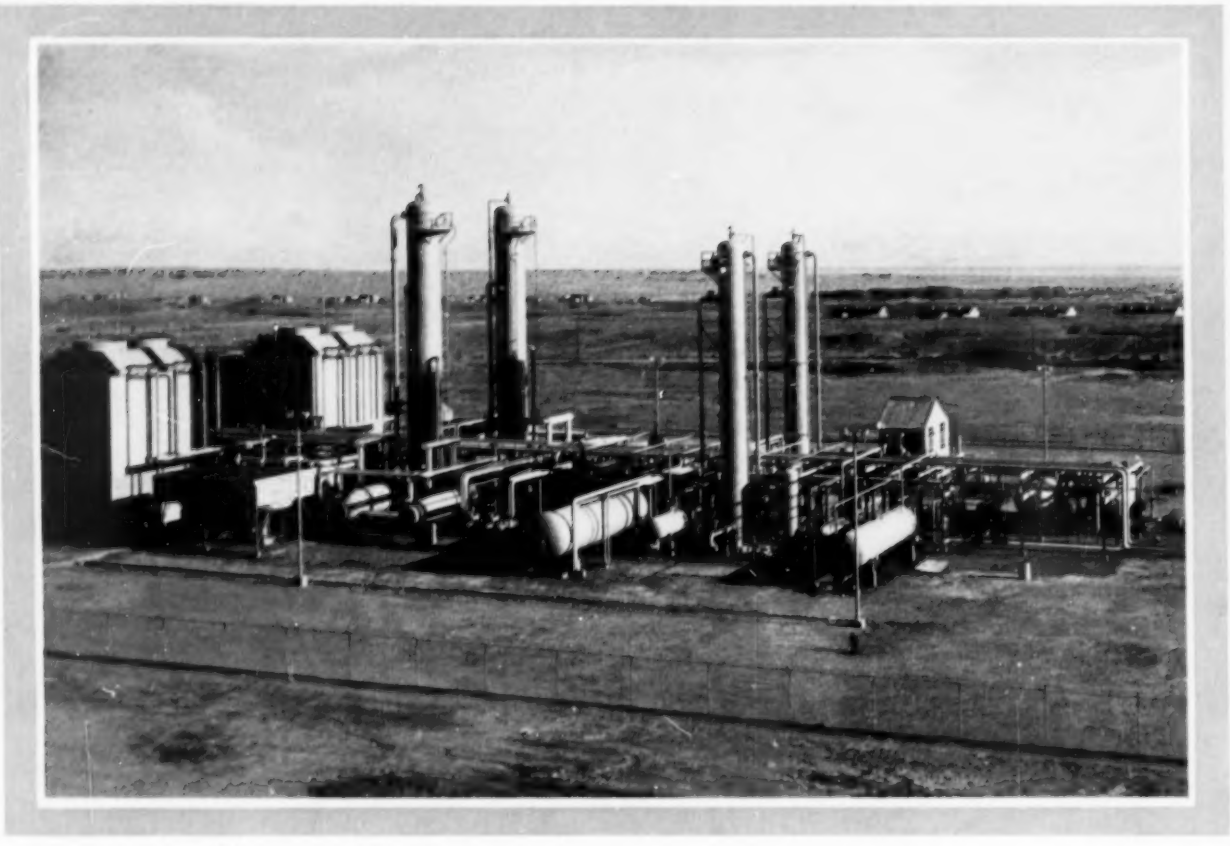
A REPORT ON WHITING—investigators' conclusions on the explosions . . . p. 39

NEED NEW IDEAS?—how a creative thinking approach can help you . . . p. 54

NEW THIS MONTH—helpful engineering data you can clip and file . . . . p. 101

PRICE 35 CENTS

A McGRAW-HILL PUBLICATION



Sui GAS STARTS TO KARACHI

This plant, the first of its kind in Asia, is located in the Sui Gas Field 350 miles northeast of Karachi in West Pakistan. It processes sour gas, removing sulphur compounds and water vapor, preparing the gas for transportation and consumption. It is a vital part of a project from which will accrue great economic advantage to Pakistan.

The work of Hudson included design, procurement of equipment, transportation, and erection using English, American and native labor.

Despite the remoteness of the plant site, the rail terminus being 40 miles across the desert, and air temperatures as high as 125 F. in the shade, the plant was completed in 12 months from start of design work.

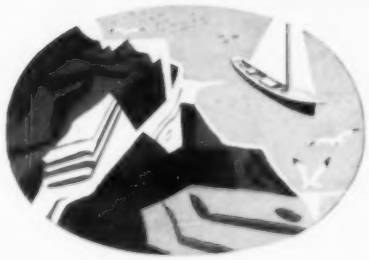
Hudson is proud to have collaborated with Pakistan Petroleum, Limited, and Sui Gas Transmission Corporation in the successful completion of this first project of its kind in Asia. The experience of Hudson gained in over 30 years in design and construction of oil and gas processing plants in the United States, Europe, Mexico and South America is available for any project large or small in any part of the world.

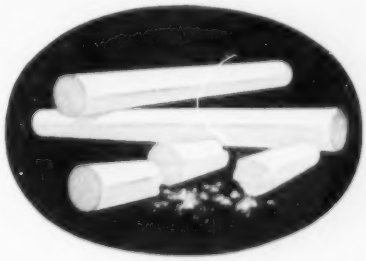
HUDSON
ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

HARSHAW *Tableted* CATALYSTS

FROM **strong** TO *soft*





as rock! *as chalk!*

whatever you specify

Typical Harshaw Catalysts:

Aluminum Chloride Anhydrous
Boron Trifluoride
Boron Fluoride Addition Compounds
Hydrofluoric Acid Anhydrous
Alumina—active or inert
Chrome Alumina
Molybdena Alumina
Tungsten Alumina
Cobalt Molybdena Alumina
Copper-Chromium Oxide
Magnesia
Nickel
Vanadium
Zinc-Chrome

Harshaw Catalysts available in these forms:

Tablets
Extrusions
Powders
Granules
Spheres
Rings
Flakes

Use Harshaw Catalysts for these processes:

Hydroforming
Cyclization
Oxidation
Dehydrogenation
Hydrogenation
Dehydration
Desulphurization
Alkylation
Isomerization

Harshaw Catalysts—made exactly to your specifications of raw materials, chemical composition, and physical properties such as length, diameter, crushing strength, abrasion resistance, bulk density, etc. *AND* delivered *when you want them!*

Harshaw has the know-how—we pioneered in making customer specified catalysts. Harshaw has the facilities—we produce *carloads* every week!

We are to you like the druggist is to the doctor . . . write your catalyst prescription and depend on Harshaw to fill it.

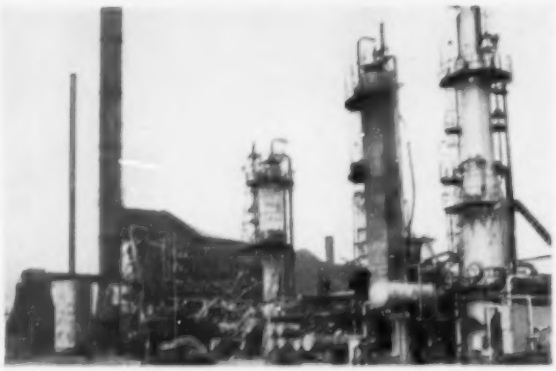
Our free booklet "Harshaw Catalysts" is yours for the asking. Write today.

The HARSHAW CHEMICAL Co.

CLEVELAND 6, OHIO

CHICAGO • CINCINNATI • CLEVELAND • DETROIT • HOUSTON • LOS ANGELES
HASTINGS-ON-HUDSON • PHILADELPHIA • PITTSBURGH

Reader's Guide — What's New in Petroleum



What Happened at Whiting?

For several months now, a team of Standard Oil Co. (Indiana) engineers has been studying the explosions and fire that took place at Whiting, Aug. 27, 1955. They've been piecing together fragments of information, searching out clues to possible and probable causes.

Here is the first report released by the company, listing nine important conclusions reached by the investigators, and describing in detail the sequence of events leading up to the explosions **p. 39**

I 2 3 4 5

"Handle With Care"

Whether you're a manufacturer or only a user of lubricants, you can profit from the tips in this article on how to keep your lubes in tip top condition. The pay-off will come in having them in shape to do a good job any time you need it. By Robert K. Gould. **p. 46**

I 3 4

Water Pollution Impossible Here

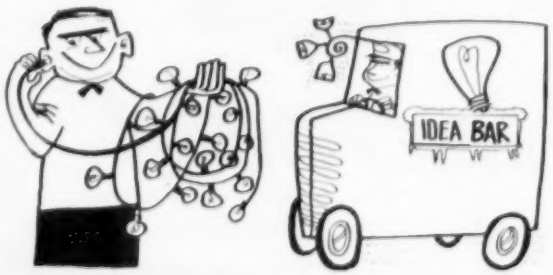
"Over the hills instead of into the river." That's the key to an improved disposal system Socony Mobil has put into its Casper, Wyo., refinery. No liquid wastes at all enter the North Platte river, but flow instead to nearby evaporation ponds. **p. 49**

I 2 3 4

The Best There Was in '55

Your response as readers to new products, supplies, and equipment, reviewed in "What's New" represents a gage of the most important new ideas developed for your field of activity. Here again is our annual review of the leading items from last year. **p. 52**

I II III 1 2 3 4 5



Are You an "Idea" Man?

Here's some practical, down-to-earth tips on what creative thinking can do for you, no matter what your problem is—how to get new ideas: how to keep them coming: what to do when you're stumped: what to do with ideas after you've got them. By Robert L. Davidson **p. 54**

I II III 1 2 3 4 5

A McGRAW-HILL PUBLICATION

ABP ABC

Member of Associated Business Publications and Audit Bureau of Circulations

Petroleum Processing is published monthly by McGraw-Hill Publishing Co., Inc., James H. McGraw (1860-1948) founder.

Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 West 42nd St., New York 36, N. Y. Donald C. McGraw, President; Paul Montgomery, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Joseph H. Allen, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Circulation Director.

Subscriptions: Address correspondence to Petroleum Processing, Subscription Service, 330 West 42nd St., New York 36, N. Y. Subscription rates: domestic single copies, 35¢, U. S. and possessions, Canada, and all other countries, $2 per year, $3 for two years, $4 for three years. Orders must indicate company and position.

Published prior to Sept. 1946 as the Technical Section of National Petroleum News, devoted to Refinery Management and Petroleum Chemical Technology, and including International Petroleum Technology.

Second class mail privileges authorized at Chicago, Ill. Printed in U.S.A. Copyright 1956 by McGraw-Hill Publishing Co. All rights reserved.

Processing for January, 1956

PETROLEUM REFINING I | PETROCHEMICAL MANUFACTURING II | GAS LIQUIDS RECOVERY III | RESEARCH & DEVELOPMENT 1 | DESIGN & ENGINEERING 2 | PLANT OPERATION 3 | MAINTENANCE & CONSTRUCTION 4 | MANAGEMENT & PERSONNEL 5

Combination Processing in Iraq

Five major operations in one–distillation, vacuum flashing, thermal cracking and reforming–as installed in the new 24,000 b/d government refinery near Baghdad, described by members of the Iraq oil refining administration and the plant operating staff. **p. 58**

I 1 2 3 4

Ammonia from Cat Reformer Hydrogen

. . . at Atlantic Refining Co.'s Philadelphia refinery, using operating pressures below 3000 psig. Unusually pure synthesis gas allows manufacture of refrigeration grade ammonia, without purging by inerts during operation. By J. H. Arnold and W. T. Dixon **p. 62**

I II 1 2 3 4

Is Your Fuel Oil the Best?

The biggest problems affecting the quality of fuel oil are storage stability, sludge, and gel formation. Here is a meaty discussion of the basic causes of these problems and what today's processors can do about them. By J. B. Kirchner, D. P. Osterhout, and W. R. Schwindeman. **p. 67**

I 1 3 5

How to Select Refractory Castables

Comparative testing is the best. Proper choice depends on several factors other than the maximum service temperature – shutdown frequency, temperature cycling, methods of cooling, and runaway temperatures for example. By C. M. Vogrin and H. Heep. **p. 72**

I II III 1 2 3 4

A Must for Good Control

Control valves will not operate properly if the nearby piping is wrong. Improper manifold design and installation can offset all the care you put into choosing the right valve. Here is information on the effects of commonly used valve-manifold arrangements on process control. **p. 76**

I II III 2 3

Your "Clip-n-File" Process Data

This new special department, perforated for quick and easy removal for your own process handbook. This month's subject: **p. 89**

Anhydrous Ammonia by the L'Azote Process

I II 2 3

NEW

And Here's Another "Clip-n-File"

A new feature this month – and every month from now on – is this two-page engineering data sheet. Like the monthly process data sheet, it too has been designed for your convenience. It is perforated for easy removal, and punch holes are indicated so it can be kept in a loose-leaf binder. This month's topic:

I 5

Pressure Fundamentals

What pressure is, how it is measured, the units of measurement, and some handy tables of equivalents **p. 101**

I II III 2 3

DEPARTMENTS

Publishers Page	7	New Words	109
What's Happening	9	Patents	111
Tomorrow	15	Suppliers	117
Process Data Sheet	89	Meetings	121
Plant Practices	93	Books	123
Operating Trends	97	Information Offered	124
Engineering Data Sheet	101	Advertisers' Index	126
Personals	105	What's New	129
Editorials	160		

Continue "Readers' Guide" on p. 85

HOW TO USE IT:

Your new "Reader's Guide to What's New in PETROLEUM PROCESSING" will do two things for you. First, the key numbers with each article will tell you at a glance if it is within your scope of interest; Roman Numerals indicate industries; Arabic Numerals, fields of activity. Second, the longer descriptions will tell you what each article is about, and why it can be of help and interest to you. –THE EDITORS

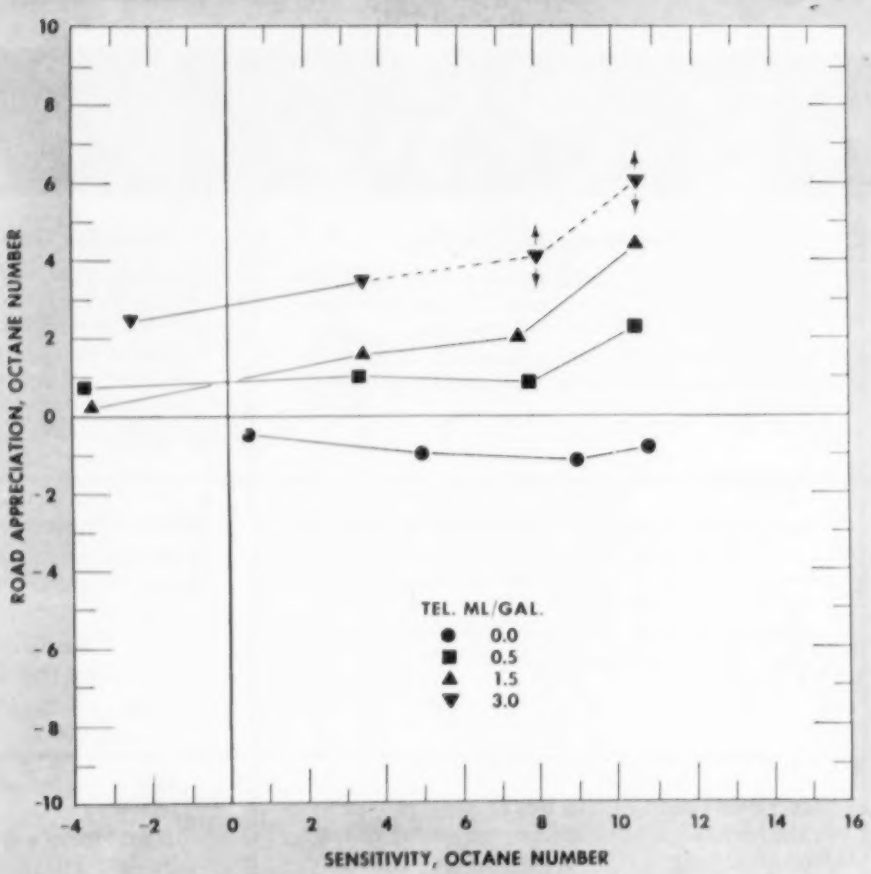


Fig. 1. Sensitivity versus appreciation. Note that the appreciation at any given sensitivity level increases with lead concentration.

Blending Hydrocarbons for
Maximum Octane Potentials

By F. D. BUERSTETTA
Ethyl Corporation, Detroit, Mich.

The manufacture of high-octane gasolines to meet today's and tomorrow's automotive demands is putting increasing pressure on the refiner. To meet these requirements, the available hydrocarbon components in the refinery must be blended to best advantage to give maximum performance on the road.

Each octane number at the 100-octane level may cost as much as 15 to 20 cents per barrel. Thus there is a marked incentive for insuring that every laboratory octane number, obtained at this great expense, provides corresponding antiknock performance in cars on the road.

Hydrocarbon blends studied

As part of a continuing Ethyl Research program to establish the fundamentals of laboratory versus road antiknock quality, a study was recently conducted in which the behavior of blends of pure C_7 and C_8 hydrocarbons was examined.

Within this C_7-C_8 range, the four basic hydrocarbon types — olefins, paraffins, naphthenes and aromatics — were blended in varying proportions. Actually, a mixture of isooctane and *n*-heptane was used as the paraffin constituent to permit maintenance of a constant Research octane number while investigating the effects of tetraethyllead concentration and variations in hydrocarbon-type composition. Toluene, diisobutylene and methylcyclohexane were selected to represent the aromatics, olefins and naphthenes, respectively. Each of these hydrocar-

 (To obtain more data on advertised products see page 126)

Send for your free copy of a technical paper entitled "Octane Possibilities with C_7-C_8 Hydrocarbons" by F. D. Buerstetta and T. W. Warren. Address your request to Box 13, Ethyl Corporation, 100 Park Avenue, New York, N.Y.

bons was blended in concentrations of 20, 40 and 60 per cent by volume with the proper paraffin mixture, giving nominal Research octane levels of 92, 96 and 100 at each of four tetraethyllead concentrations—0.0, 0.5, 1.5 and 3.0 ml. per gallon.

Each blend was evaluated in single-cylinder laboratory test engines and was then rated in the 9 to 1 compression-ratio engine of a 1955 passenger car equipped with an automatic transmission. Road ratings were made by both the Modified Uniontown and Modified Borderline techniques.

Road appreciation defined

Some of the test results are summarized in Table 1 in terms of road appreciation, which is the road antiknock rating of a fuel minus its Research octane number—or the bonus obtained in actual engine performance over the indicated laboratory knock rating.

The general analysis of data shown in Table 1 may permit a refiner to achieve better road performance than could be secured by using only Research octane number as a guide. It will be seen that aromatics should be maximized and olefins minimized as much as possible when making top-octane fuels. Since most of today's catalytic reforming processes eliminate naphthenes through dehydrogenation to aromatics, consideration of them is somewhat academic, but nonetheless interesting.

Further evaluation of the large quantity of test data obtained from this project indicates a most interesting correlation between appreciation and the concentration of tetraethyllead. Figure 1 shows a plot of sensitivity versus appreciation with points representing the same tetraethyllead concentrations connected. It can be seen from Figure 1 that the appreciation at any given sensitivity level increases with lead concentration.

Conclusions

The general conclusions which can be obtained from the study are as follows:

1. Best over-all antiknock performance can be obtained by blending a high proportion of aromatics with paraffins and adding the maximum amount of tetraethyllead.

2. Where low-speed knock resistance is critical, high aromatic content is necessary.

3. Where high-speed antiknock performance is critical, high aromatic content is less important, but maximum tetraethyllead concentration is still essential.

Table 1. Average change in road antiknock appreciation with addition of aromatics, olefins or naphthenes to paraffins in the C_7-C_8 range.

Research Octane No.	Added Component	Modified Uniontown	Modified Borderline	
			Low Speed	High Speed
92	Aromatics	+0.6	+1.1	+0.6
	Olefins	+0.3	+1.1	−2.0
	Naphthenes	+0.6	+2.0	+3.8
96	Aromatics	+0.9	+1.7	+0.6
	Olefins	+1.6	+1.1	−3.3
	Naphthenes	+2.4	+4.2	+2.7
100	Aromatics	+0.8	+1.5	−0.7
	Olefins	+0.5	+0.0	−5.7
	Naphthenes	+3.4	+3.7	+1.7

HOW Ethyl Research can help you

At today's high octane levels, the science of blending hydrocarbons has taken on more and more importance. As a service to the oil industry, Ethyl Research has launched a hydrocarbon blending program of its own to complement the intensive effort which the industry is devoting to this problem.

We are now testing many new blends in our laboratories and in high-compression engines on the road. Much of the data from these tests is being interpreted in terms of "road appreciation" to give refiners a better idea of the effectiveness of each blend. Write for a copy of "Octane Possibilities with C_7-C_8 Hydrocarbons"—another in the continuing series of reports from the Ethyl Corporation on fuel blending and other studies of vital interest to refiners today.

For further information, just call your Ethyl Representative. He'll be happy to arrange an appointment for you with one of our Technical Representatives.

ETHYL CORPORATION
New York 17, N. Y.

Research Laboratories:
1600 W. Eight Mile Road, Ferndale 20, Mich.
2600 Cajon Road, San Bernardino, Calif.

General American

offers you the best in

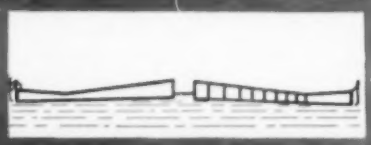
All types of Floating Roofs

WIGGINS HIDEK*

This is the natural design for storage of volatile products. A variable volume of vapor trapped beneath the steeply-pitched, quick-draining deck adds to its efficiency.

WIGGINS LODEK*

Designed so that the underside is in complete contact with the liquid surface. No vapor space can exist beneath the floating roof. Especially recommended where corrosive products are stored.



WIGGINS DOUBLEDEK*

If you prefer a double-deck roof choose the best—the new Wiggins Doubledek. Complete drainage design and between-deck accessibility add up to unmatched efficiency and safety.

WIGGINS FLOATING ROOFS PAY FOR THEMSELVES

Whatever your Floating Roof requirements get General American's UNBIASED analysis. Unbiased because General American makes ALL types of Floating Roofs!

Wiggins Floating Roofs, Dry Seal Gasholders, Lifter Roofs, Cone Roofs

*patented

VAPOR SEAL GENERAL AMERICAN TRADE MARK

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South La Salle Street • Chicago 90, Illinois

(To obtain more data on advertised products see page 126)

Petroleum Processing

A McGRAW-HILL PUBLICATION

Editorial & Business Offices

330 West 42nd St., New York 36, N.Y.

Harry L. Waddell, *Publisher*

Editorial Staff

William F. Bland, Editor
William C. Uhl, Managing Editor
Virgil B. Guthrie, Associate Editor
Robert L. Davidson, Assistant Editor
Willis A. Bussard, Assistant Editor
Alan Corneretto, Assistant Editor
William A. Caperell, Jr., Art Director
Stuart D. Boynton, Editorial Assistant
Grace McKay, Editorial Assistant
Ronald E. Cannon, Southwestern Editor
W724 Prudential Bldg., Houston 25
Richard R. Elwell, West Coast Editor
1111 Wilshire Blvd., Los Angeles 17
Andrew R. Patla, Washington Editor
1188 Nat'l. Press Bldg., Washington 4
Peter J. Gaylor, Patent Reviewer

Business Staff

K. W. McKinley, Advertising Sales Mgr.
R. H. Layer, Business Mgr.
John E. Thompson, Production Mgr.
George Reid (Houston)
Assistant to the Publisher

Regional Sales Representatives

NEW YORK 36, N. Y.
Fred R. Emerson, 330 West 42nd St.
Walter W. Patten, 330 West 42nd St.

PHILADELPHIA 3, PA.
Fred R. Emerson, 17th and Sansom Sts.

ATLANTA , GA.
S. T. Henry, 801 Rhodes-Haverty Bldg.

CLEVELAND 15, OHIO
William R. Freeman, 1510 Hanna Bldg.

CHICAGO 11, ILL.
Robert W. Bruley, 520 N. Michigan Ave.

HOUSTON 25, TEXAS
J. H. Cash, W724 Prudential Bldg.

DALLAS 1, TEXAS
J. H. Cash, Room 1020, Adolphus Tower
Douglas C. Billian, Room 1020, Adolphus Tower

SAN FRANCISCO 4, CALIF.
T. Evans Wyckoff, 68 Post St.

LOS ANGELES 17, CALIF.
William C. Woolston, 1111 Wilshire Blvd.

Publisher's Page

Would You Like a Better Notebook?

CARL HARPER is an engineer. He works for a major oil company—and he reads PETROLEUM PROCESSING (as you might suspect). Carl Harper isn't his real name—but let's call him that anyway.

I see Carl every now and then. When I'm in the field and get to his town I always give him a call. He's usually busy, since he's a group leader with a dozen other fellows under him. But he's never too busy to talk about his job and the industry for a few minutes.

The last time I saw Carl he was not a happy man. He tossed a notebook on his desk and told me to "take a look at that mess."

I did. And when he said "mess" he wasn't kidding. It was a 3-ring binder, crammed full of sheets of paper. It was a hodge-podge of magazine clippings, reprints, advertisements, and even handwritten notes. Some were small—some were big—and some were too big and stuck out their frayed edges.

"Bill," he said sadly, "that collection of data is the bane of every engineer. There isn't one of us who doesn't have it in one form or another—a notebook, a folder, or just a drawer full of papers. It's a personal collection of helpful data—tables of values, conversion factors, handy formulas, and the like.

"After a bit, we can't get along without the stuff—yet I'll be damned if I can get along with it. I know what's in there—but half the time I can't find it when I want it. There's no way to index the stuff—and there's no way to keep it neat. What can you do to help me?

I don't know that we've got the entire solution for Carl—but we've at least made a start in the right direction. There's a new "Clip-n-File" department starting in this issue of PETROLEUM PROCESSING—our "EDS" or "Engineering Data Sheet."

Now I know that such Data Sheets aren't novel. But we're doing two things with our "EDS's" to make them better for you. First, they're printed on good, heavy stock that can stand a lot of use; they won't get all tattered and torn. Second, the sheets are perforated so you can remove them easily and neatly from the magazine. On top of that, each sheet will carry a subject tab on the edge to help you with your indexing.

Take a look at "EDS No. 1" in this issue—pages 101 and 10. — and then use it and the coming ones to improve your own notebook.

And if you have some ideas on what you'd like to see covered in future EDS's, drop me a line. We're here to help you.

William F. Bland

—Editor

Other McGraw-Hill Petroleum Publications

National Petroleum News
The monthly magazine of oil marketing—news, prices, transportation, storage merchandising

Platt's Oilgram News Service
A daily independent oil-news reporting service issued from New York, Chicago, Houston

Platt's Oilgram Price Service
A daily independent oil-price reporting service issued from New York, Chicago, Houston

Petroleum Week
The industry-wide magazine—covering production, processing, transportation, marketing

. . . as corrosive as hydrochloric acid
. . . as critical as caustic soda
. . . as volatile as chloroform
as viscous as molasses
problem liquids

are stored safely in General American tank storage terminals

Easy-to-handle liquids and problem liquids alike . . . they're all in a day's work for the men at General American terminals. Storage capacity of over half-a-billion gallons is available for any liquid that can flow through a pipeline.

Facilities are also available for blending to your specification . . . for drumming, barreling and canning to meet your needs. You get the privacy, service, safety and flexibility of your own terminals without capital investment.

By maintaining liquid inventories at General American terminals, you can fill rush orders for your customers or meet your own needs quickly, efficiently and economically.

It Pays To Plan With General American

Terminals located at:

Port of New York (Carteret, N. J.)
Port of New Orleans (Good Hope, La.)
Chicago, Illinois (Bedford Park)
Port of Houston (Galena Park and Pasadena, Texas)
Corpus Christi, Texas

GENERAL AMERICAN TANK STORAGE TERMINALS
a division of **GENERAL AMERICAN TRANSPORTATION CORPORATION**
135 South La Salle Street • Chicago 90, Illinois

What's Happening...

in Refining

. . . 8,399,700 b/d was the nation's operable refinery capacity as of Dec. 31, incomplete API figures show. This is expected to grow to 9,582,800 b/d by Sept. 30 of this year, with the Texas Gulf area, nation's largest refining center, accounting for the greatest increase—66,708 b/d. Figures by areas, in thousands of barrels, are:

Refining Districts	Dec. 31 1955	Sept. 30 1956	% Inc.
East Coast	1,169.4	1,183.4	1.2
App'n No. 1	108.4	108.4	
App'n No. 2	94.5	94.5	
Ind.-Ill.-Ky.	1,534.0	1,597.9	4.2
Okla.-Kan.-Mo.	763.2	763.4	
Inland Tex.	293.8	308.2	4.9
Tex. Gulf	1,982.4	2,049.1	3.4
La. Gulf	689.9	691.1	0.2
No. La.-Ark.	98.3	98.6	0.3
Rocky Mt.-N.M.	26.1	26.1	
Other Rocky Mt.	293.5	303.5	3.4
California	1,346.2	1,358.6	0.9
Total U.S.	8,399.7	8,582.8	2.2

. . . Rapid tax write-off approvals have been made by the Office of Defense Mobilization on the following projects:

Tide Water Associated Oil Co.—42,000 b/d coking unit, 20,000 b/d hydrodesulfurization unit, and expansion of cat cracking unit, Avon, Calif., 65% on $17,855,000, 45% on $6,120,000; and 15% on $70,000.

Aurora Gasoline Co.—6000 b/d Rexformer and office expansion, Detroit, Mich., 65% on $652,150.

Warren Petroleum Co.—natural gasoline plant and gathering facilities, Lea County, N. Mex.; 65% on $1,578,824; and 40% on $132,209.

. . . Alberta Co-operative Wholesale Assn. and the United Farmers of Alberta Co-operatives Ltd, two of Alberta's big, consumer owned, marketing co-operatives, are joining forces for eventual construction of their own refinery.

Construction plans for near future

. . . Commerce Oil Refining plans to start building its $30-million, 30,000 b/d refinery near Portsmouth, R. I., in February. Though the State Supreme Court has not ruled on a legal challenge to the location, Lummus is working on the design, and Commerce says capacity may be upped to 45,000 b/d. Site is about 5 mi. from where Paragon Oil will build (see below).

. . . Paragon Oil Co. plans a 30,000 b/d refinery on a 750-acre site it has purchased in Tiverton, R. I., near Fall River, Mass. Planning is based on use of Gulf Coast crude. J. F. Pritchard & Co. is doing initial design studies.

. . . Shamrock Petroleum is planning to build North America's most northernmost refinery at Whitehorse, in Canada's Yukon Territory, about 1,000 mi. northwest of Edmonton, Alberta. Fluor Corp. is expected to be awarded design and construction contracts for the 2,000 to 3,000 b/d plant. Crude will be shipped by tanker from Vancouver.

. . . Texas Asphalt and Refining is planning a $1-million, 2,500 b/d asphalt plant on the Houston, Texas, ship channel for completion around mid-year.

. . . Western States Refining is planning to build other facilities as well as a Houdriformer at its North Salt Lake City, Utah, refinery. Funds will be raised by a $1.05-million debenture issue later this month. The Houdriformer is already under construction by J. C. Hinds & Co.

. . . The Texas Co. will install a new 80,000 b/d crude unit at Port Arthur, Texas, during 1956, as well as a Fluid catalytic cracking unit—capacity not decided. Some older stills are to be eliminated; and overall plant capacity will be upped from 210,000 to about 230,000 b/d. (For more on Texas, see below.)

Contracts awarded recently

. . . Phillips Petroleum to Gasoline Plant Construction Co. for $7-million gas absorption plant, gathering lines, and booster station near Andrews, Tex.

. . . Ingram Oil and Refining to Southwestern Engineering for $1-million construction of new facilities at Ingram's Meraux, La. refinery. New units scheduled for completion by April, include 3,000 b/d Platformer, prefractionation and light straight run gasoline stabilization equipment.

. . . International Refineries to Parsons for a $1.5-million improvement program at its 10,000 b/d Wrenshall, Minn., refinery. Construction is starting immediately.

. . . Continental Oil to Refinery Engineering for design and construction of a 1,500 b/d Houdriformer at Continental's Artesia, N. M. refinery.

. . . Imperial Oil to Fluor of Canada for 13,500 b/d cat reformer for its Sarnia Refinery. Part of a $5-million program of equipment modernization, completion of the unit is scheduled for fall of this year.

And to Brown and Root for a $3-million, 10-million cf/d gas absorption plant at Redwater, Alberta.

. . . American Gilsonite to H. K. Ferguson for construction of cat reformer and hydrogen plant at American Gilsonite's proposed Grand Junction, Colo. refinery.

. . . **The Texas Co.** to Refinery Engineering for design and construction of a hydrotreater and a visbreaker at Texaco's Westville, N. J. refinery. Units are part of an expansion that will raise the Eagle Point's capacity from 60,000 to about 66,000 b/d.

New refineries and units recently on stream

. . . **X-L Refineries** $2-million Peace River, B. C. refinery.

. . . **Continental Oil's** $700,000, 15,000 cf/d natural gasoline plant near Sussex, Wyo.

. . . **Famariss Oil and Refining's** 650 b/d combination UOP Platforming-Unifining unit at Hobbs, N. M.

. . . **D-X Sunray's** 7,000 b/d delayed coking plant at its West Tulsa refinery.

. . . **Champlin Refining's** $2.5-million 9,000 b/d Orthoflow cat cracker at its Enid, Okla. refinery.

. . . **Rock Island Oil and Refining's** 300 b/d Unifiner, the first to be electronically controlled, at Indianapolis, Ind.

in Petrochemicals

. . . **Goodrich-Gulf Chemicals** has purchased the government's 137,000 t/yr synthetic rubber plant for $11-million. The Institute, W. Va., plant was the government's largest.

. . . **Polymer Corp.,** the Canadian government's synthetic rubber company, is considering building a butadiene plant in Alberta as part of government's aid to the Trans-Canada natural gas pipeline builders. Plant would buy butane stripped from wet gas in field.

Construction plans for near future

. . . **Texas Co.** is planning a 180 t/d anhydrous ammonia and derivatives unit at its Lockport, Ill. refinery. Construction will start later this year.

. . . **Borden** will build an 18,000 t/yr formaldehyde plant in Seattle, Wash., for completion late this year.

. . . **Shell Chemical** has plans for a 20,000 t/yr methyl ethyl ketone plant at Norco, La. for completion early in 1957.

. . . **Montana Sulfur and Chemical** plans a sulfur plant near the Billings refineries of Carter Oil, and Continental, to use their hydrogen sulfide gas.

. . . **Koppers Co. and Brea Chemicals** have plans for a 25,000 t/yr Ziegler-type polyethylene plant to go up on the Pacific coast in 1957.

. . . **National Farmers Resources, Inc.,** a subsidiary of National Farmers Union, is planning a large fertilizer venture in Utah for 1956. Included are: a $12-million, 125 t/d anhydrous ammonia plant in Sanpete County, a $5-million phosphate and sulfuric acid plant in Rich County, and a fertilizer pelletizing plant probably in Salt Lake City.

. . . **General Tire and Rubber, and El Paso Natural Gas** will start immediate construction of a 45,000 t/yr, completely integrated synthetic rubber plant. The $30-million project is scheduled for completion in mid-1957 in Odessa, Tex.

Petrochemical expansion news

. . . **Dow Chemical** plans a $5-million program for Sarnia this year, including a $1-million pentachlorophenol plant, a $3-million ethylene plant, and a $1-million ethanolamine plant.

. . . **Stauffer Chemical** is adding 8,000 sq. ft. of space to its Chauncey, N. Y. research center.

. . . **Petroleum Chemicals** will boost the capacity of its existing Lake Charles, La. butadiene plant from 63,000 to 79,000 t/yr. at an estimated cost of $4.35 million. Contract for the proposed new butadiene plant at Lake Charles has been given to Fluor.

in Foreign Operations

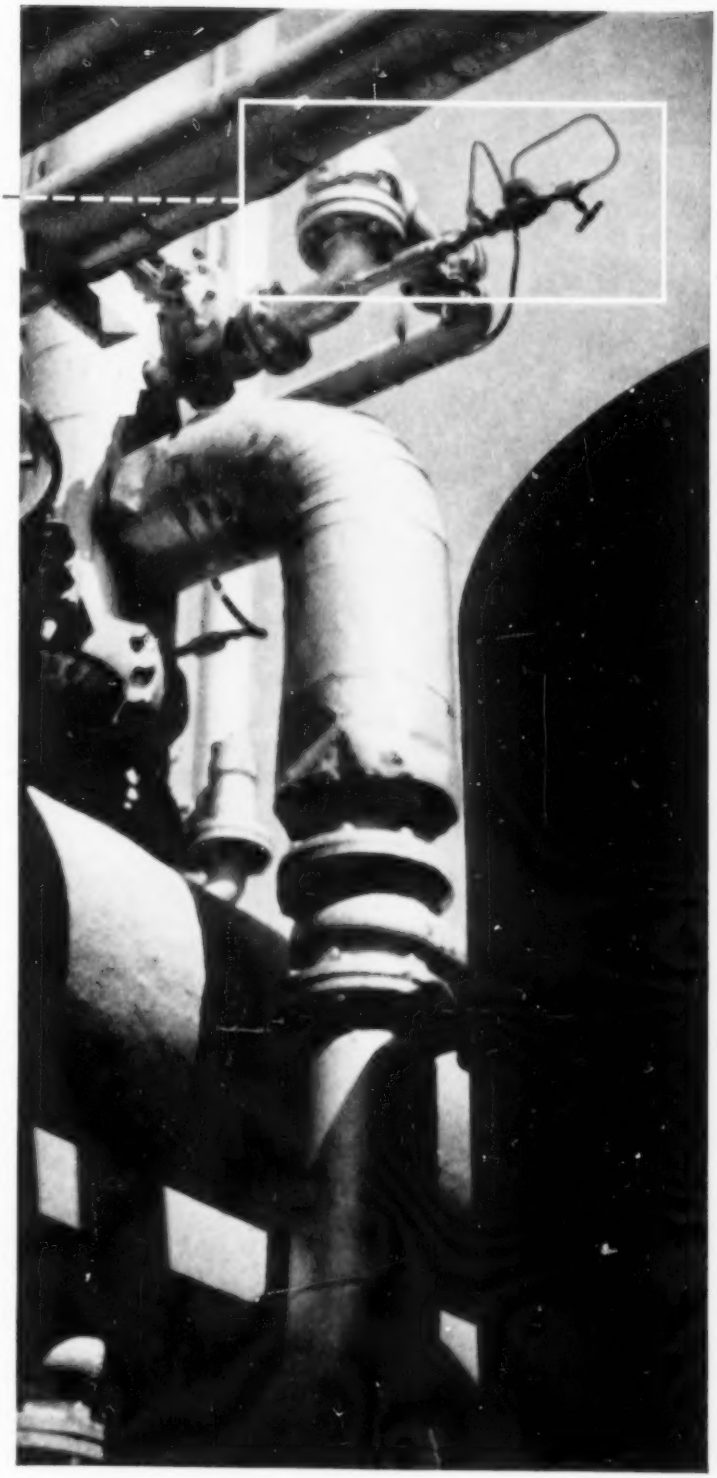
LATIN AMERICAN NOTES . . . The Texas Co. is starting construction of its $14-million, 20,000 b/d refinery at Santiago de Cuba to be completed early next year. Procon will design and build the process units . . . **Placco Puerto Rico** expects its new $300,000, 50,000 b/yr industrial asphalt plant to be in operation by mid-January of next year . . . **Mene Grande Oil,** in Venezuela, is getting a Brown and Root designed semi-portable gasoline plant which will process 10-million cu/ft of 600 psi gas daily for production of 26 lb RVP stabilized gasoline . . . **Cia Shell de Venezuela** will boost capacity of its Cardon refinery to 255,000 b/d by installing an 80,000 b/d distillation unit, its fourth at Cardon . . . **Glen McCarthy** is planning a 3,000 b/d refinery in Paraguay to process his Bolivian oil production.

In Petrochemicals . . . Pemex, the Mexican government's oil company is negotiating with Phillips Petroleum for a license to use its Marlex low pressure process for polyethylene production.

U.K. NOTES . . . Great Britain's total refinery output in 1955 reached 580,000 b/d, up about 20,000 b/d from 1954 . . . **Jersey Standard affiliates** will expand their Fawley refinery and Abingdon labs, both in England; they plan to build new refineries in "a number of other European countries," (see below) . . . **British Petroleum** is considerably expanding its research station near London, B.P., has also upped its Grangemouth refinery's LPG bottle filling capacity to almost 400 b/d.

In Petrochemicals . . . International Rubber Co., Ltd., a new British group of five big rubber com-

LIFELINE FOR A REFINERY



This thin loop of copper tubing is the mark of a refinery that has learned to combat corrosion and fouling the modern Polyrad way. This is the injection line for Polyrad—and it can well be called the "lifeline" for refinery equipment.

Polyrad is a filming amine that acts both as an inhibitor and detergent. Its detergency maintains throughput, increases heat transfer, and cuts down time for maintenance. At turn-around time you really see the difference—Polyrad-protected bundles are free of corrosion, ready for immediate return to service.

Stocks of Polyrad are maintained throughout the country. A Hercules trained representative will be glad to discuss its application to your specific operating conditions.

Pine Chemicals Division, Naval Stores Department

HERCULES POWDER COMPANY

984 King Street, Wilmington 99, Del.

POLYRAD®

FILMING AMINE INHIBITOR

panies, is planning a $25.2-million 50,000 t/yr synthetic rubber plant. Production is set for 1958. . . . **Shell Chemical's** new Shell Haven plant will have a production of 20,000 t/y of alkIbenzene.

MIDDLE EAST NOTES . . . NOA, Soles Boneh, and Ampal, three Israeli oil companies are planning a $12-million lube oil plant, first in Israel . . . **British Petroleum** plans to spend between $14-million—$16-million on expansion of its "Little Abadan" refinery at Aden. A thermal reformer and a cat polymerization unit will be added to the 100,000 b/d, year-and-a-half-old plant . . . **Mediterranean Refining's Sidon** refinery has increased throughout from 6,250 to 9,000 b/d. A UOP Platformer, third in Middle East, has been added.

FAR EAST NOTES . . . Shell, British Petroleum, Caltex, and Standard Vacuum are negotiating with the Ceylon government on the final details of a long planned $30-million, 21,000 b/d refinery expected to go on stream sometime in 1958. . . . **Assam Oil,** with a 7,500 b/d refinery in Digboi, India, would build another if more crude were found in Assam.

In Petrochemicals . . . The Indian government is planning a $21-million fertilizer plant at Trombay Island that would operate off the waste gases from the Stanvac and Burmah-Shell refineries near Bombay. . . . **Nihon Gas Kagaku,** of Tokyo, will build an $8.3 million, 90 t/d urea-from-natural-gas plant designed by CCC, and a 100 t/d ammonia plant . . . **Dow** will invest about $84-million in Japanese polystyrene production.

EUROPEAN NOTES . . . Societa Augusta Petrolchemica plans a 20,000 b/d refinery, using Middle East crude, at Palermo, Italy . . . **Saroms's** 35,000 b/d refinery at Ravenna hopes to have its 4,000 b/d Isoplus Houdriformer, first in Europe, on stream by June. . . . **Norsk Esso** is planning a 30,000 b/d refinery for possible erection near Halden, Norway. . . **Esso AG of Hamburg** will build a 60,000 b/d refinery to serve the Rhineland area.

In Petrochemicals . . . Godfrey L. Cabot will form a company to build a 40,000 t/y carbon black plant in France at the Berre Lake refining center in mid-1957.

RUSSIAN AND SATELLITE NOTES . . . Russia has offered Syria a complete, very low priced refinery. Though Syria is receptive to other offers, only other received is from Yugoslavia . . . **Czechoslovakia** has made similar offer to Austria. . . **Hungary** has started operations at a test refinery using a new method of obtaining Diesel fuel. . . . **East Germany** is planning production of synthetic jet fuel.

in Transition

. . . **Leonard Refineries** is taking over the business and properties of Mid-West Refineries, and Roosevelt Oil and Refining in Michigan's largest oil industry merger ever. Leonard is aiming toward full integration.

. . . **Ohio Oil Co.** will close its 6500 b/d Lovell, Wyo., refinery some time after Aug. 1, because it is "no longer economically sound." Crude runs to this plant during last two years have averaged only 3000 b/d. Ohio's refining will be concentrated at its 40,000 b/d Robinson, Ill., refinery after Lovell is shut down. Disposal plans are unmade.

. . . **Pacific Refiners** stockholders have approved sale of its Honolulu facilities to Honolulu Gas Co. and Standard of California, which will pay $2,425,000.

. . . **Catalin Corp. and Reichold Chemicals** have discontinued negotiantions that were to lead to the recently announced merger.

in Markets and Prices

. . . **Winter didn't start officially** until Dec. 21. But colder-than-normal weather east of the Rockies throughout the month took a huge chunk out of the nation's light and heavy fuel oil inventories, tightened the supply position of these oils in all primary markets, and sent prices climbing.

There was no scarcity of distillate fuel offerings in the basic supply areas—Gulf Coast and Mid-Continent —but scarcity of barges and tankers, and inland waterways clogged with ice, tended to hold down the volume of open market trading. River barges were entirely committed to contract shipments. And rates for tankers, single voyages, from the Gulf to New York, jumped the equivalent of 2¢ gal.

. . . **Prices were quick** to reflect the large volume of fuel oil taken out of primary markets by the movement against contracts. At the Gulf, the cargo price for No. 2 fuel rose from 8.5¢ to 8.75¢ gal. In the Mid-Continent, Group 3 quotations for No. 2 fuel advanced 0.5¢, from 8.25¢ to 8.75¢, and No. 6 fuel was up 15¢ bbl., from $1.75 to $1.90.

Residual fuels were tight, even more so than distillates in most areas, and understandably so, from their inventory position. Late-December nationwide stocks of residuals at 40.9-million bbl. were down 22% from the year-ago level.

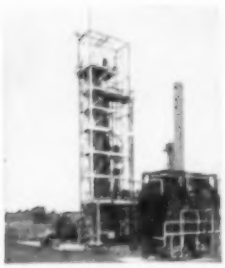
. . . **Other refined products** also appeared to be in good shape at the year-end. Refiners generally described gasoline as "unusually steady" in its off-season period. Lubricating oils were firm—the Pennsylvania field had not yet recovered from production lost during refinery fires in the summer and fall. Pennsylvania bright stock and neutral oils were up 1¢ to 2¢ gal. in December, to 22¢ for 25 pour bright and 20¢ for 200 vis. neutral.

NEW UNITS FOR PETROFINA

Completed by LUMMUS

✓ AHEAD OF SCHEDULE

✓ BELOW GUARANTEED COST



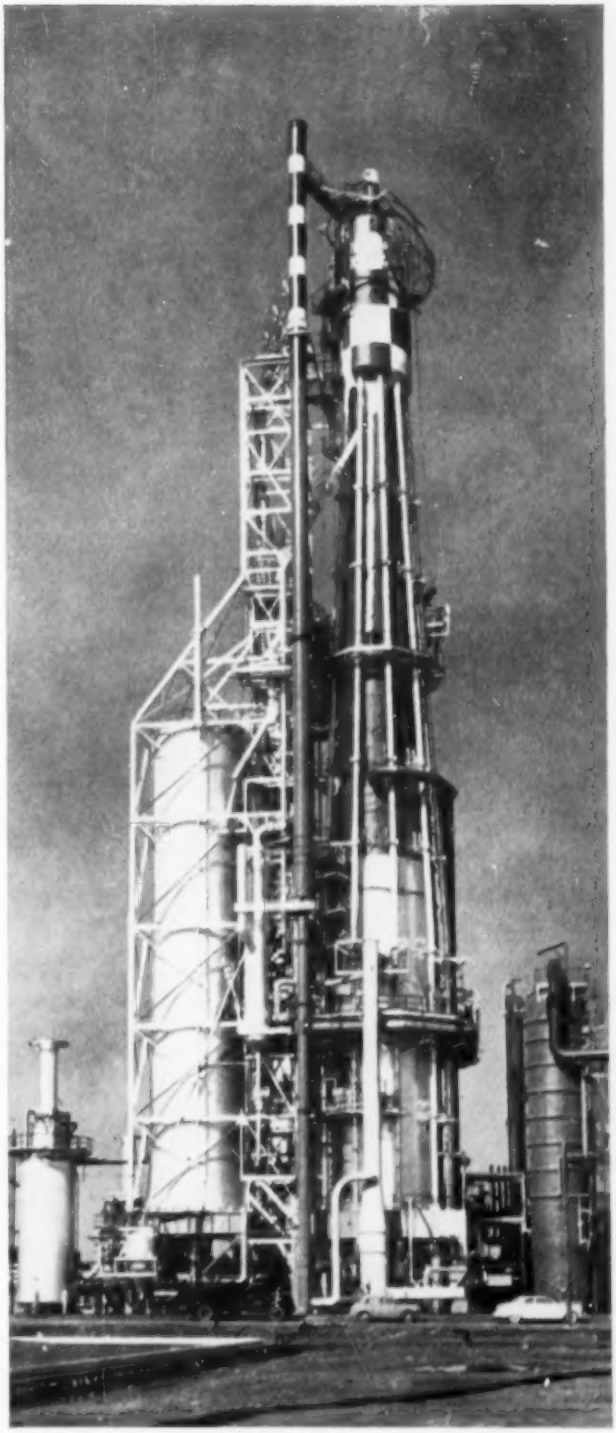
On July 30, 1955, Lummus turned over to Canadian Petrofina, Ltd., the 16,000 BSD Houdriflow Catalytic Cracking Unit and the 3,000 BSD Hydrodesulfurization Unit built at their new Point Aux Trembles Refinery near Montreal.

Construction on these two units began late in April, 1954, with the client requesting that the plant be completed by September 1, 1955. Substantially ahead of schedule by March, 1955, Lummus and the client agreed to use an absolute minimum of overtime labor for the remainder of the project to allow simultaneous completion of other refinery facilities. Even so, the two units were completed ahead of schedule, at a cost below the original guaranteed maximum.

Lummus constructed the Catalytic Cracking Unit complete with a charge heater system, Fractionation Unit, and Vapor Recovery Unit. The Hydrodesulfurization Unit (built under Shell license) is the second of these units in the world (Lummus having completed the first at Stanlow, England early in 1955). An outstanding feature of these units is the electronic instrumentation for temperatures, pressures and flow rates, complete with digital indication and adapted to automatic print-out logging and graphic panels. This is the first electronically instrumented Catalytic Cracking Unit in this hemisphere.

Lummus engineers can save time and cut costs for you on your next project.

THE LUMMUS COMPANY, 385 Madison Avenue, New York 17, New York. *Engineering and Sales Offices:* New York, Houston, Montreal, London, Paris, The Hague, Bombay. *Sales Offices:* Chicago, Caracas. *Heat Exchanger Plant:* Honesdale, Pennsylvania. *Fabricated Piping Plant:* East Chicago, Indiana.

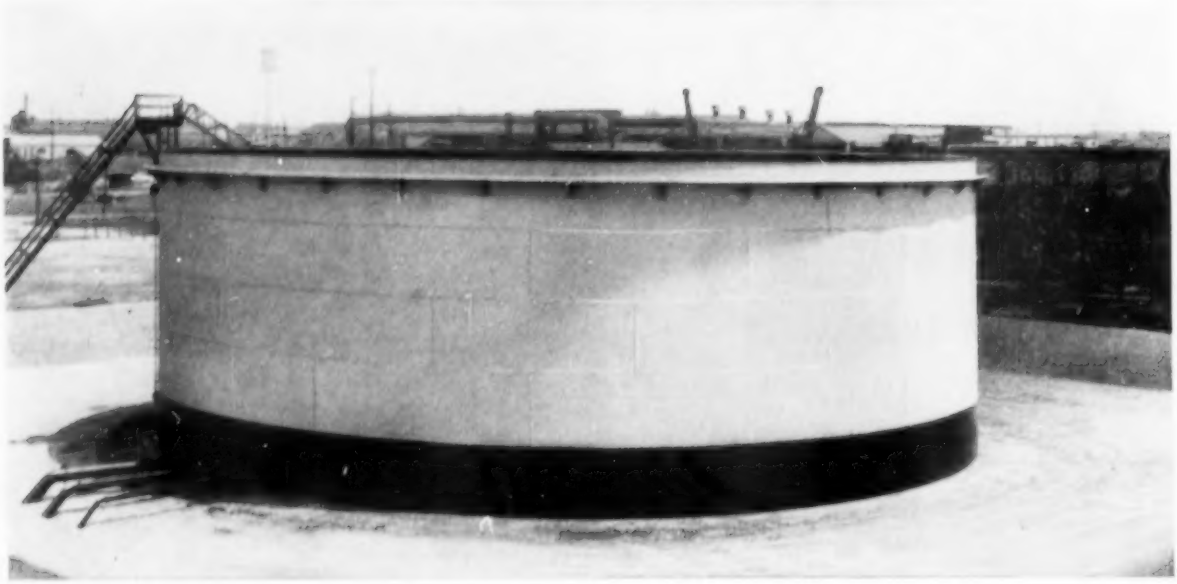


16,000 BSD Houdriflow Catalytic Cracking Unit

LUMMUS

DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

GRAVER . . . a conservation design to fit every need



GRAVER® CENTER-WEIGHTED FLOATING ROOF TANK . . . ideal for jet fuel storage

This Graver design is ideally suited for storage of jet fuels, gasolines, and other volatile liquids—especially where inclement weather is a problem. Rain water runs to the center of the roof and is carried off through a sump. The deck is clear and uncluttered, facilitating easy snow removal.

The Center-Weighted Floating Roof is unusually stable, being built to principles basic to ship hull design. Since the roof floats directly on the product, vapor losses are minimized.

Graver builds this and other tank designs to suit your specific needs.

For the utmost in economy and performance you can do no better than to contact Graver. Our engineering representatives will consult with you at no obligation.

GRAVER TANK & MFG. CO., INC.

East Chicago, Indiana

CHICAGO • NEW YORK • PHILADELPHIA • EDGE MOOR, DEL • CATASAUQUA, PA. • PITTSBURGH
CLEVELAND • DETROIT • TULSA • SAND SPRINGS, OKLA. • HOUSTON • ODESSA, TEXAS
CASPER, WYO. • LOS ANGELES • FONTANA, CAL. • SAN FRANCISCO

For THE UNITED STATES NAVY, GRAVER built these Center-Weighted and Double-Deck Floating Roof Tanks.

Electrical Home Heating—New Competitor to Distillate Sales?

THE possibility that the use of electricity may become a significant factor in home heating and thus cut into the oil industry's distillate fuel market will seem far fetched to many today. Yet, 20 to 30 years ago the same dim view was held as to the future of heating with natural gas.

The general belief today is that electric heating on a large scale is practical only in those areas which enjoy exceptionally low electric rates, such as the Tennessee Valley. The parallel picture is that natural gas was first used for home heating only in those towns close to the oil fields, where its cost was low. Then came the era of long distance gas transmission lines and the great expansion of the home heating market for gas.

Today, in the electric heating field, "something new of importance has been added," the API Division of Marketing was told at the San Francisco meeting, in November,[1] which may make the competition of the electric utilities a formidable factor in the home heating market.

"This is the tremendous increase in summer air conditioning." This, in turn, has created a serious problem for the utilities in many areas, in building up their winter loads to equalize their present summer peaks caused by the use of current in air conditioning equipment. Almost the only winter load available to meet the issue is through house heating. The utility cannot expect to acquire this load, except as it offers rates which bring heating costs within the reach of the average home owner.

"The result can be much lower electric rates for heating—low enough, in fact, to be a serious threat to oil-heating markets", the report pointed out.

Examples were given of some markets in which rates for electricity have reached the point where they are attractive for home heating. In the Tennessee Valley which has subsidized rates, it was pointed out, 90% of the new homes in Chattanooga are being equipped for electric heating, in Nashville, 80% of new homes are being electrically heated, and in Knoxville, 85%.

The Tennessee Valley in 1944 had 950 electrically heated homes. In 1954, some 100,000 homes were so heated "this in spite of the fact that the cost of electric heating in many spots is 40% higher than oil heating. Growth has been stimulated by good promotion by power companies, and by advancing prices of other fuels",[1] the report stated.

Tulsa, Okla., was cited as an example of the growth of electric heating in a competitive market and one that does not have the government subsidized rates of the Tennessee Valley. The public service company in Oklahoma has launched a $40,000,000 expanson program to add 400,000 kilowatts of new generating capacity. Its summer monthly residential peak demand increased 51% from 1953 to 1954, while its winter monthly average power demand increased only 8%.

The power company in Tulsa has such an unbalanced load as a result of summer air-conditioning demand, that it wants to drop its heating rate from 2.5 to 1.1¢/kwh, in an effort to equalize its winter-summer sales.

"It will not be necessary to offer power at rates equal to the cost of oil heating to make electric heating a real competitor," the oil companies were told at the API meeting. "The very idea of electric heating strikes a responsive chord with many buyers and, when costs come within the reach of the average home owner, good promotion will sell many electric heating installations."

The significance to the petroleum processor of a development of this type is of course in the possible effects on demands for fuel oil products. The industry will be watching this field very closely for the next several years. —V.B.G.

(1) "Why Electric Heating Will Become a Strong Competitor of Fuel Oil," A. J. Becker, president, Becker Marsden Co., St. Louis; before Division of Marketing, 35th Annual Meeting, American Petroleum Institute, San Francisco, Nov. 14, 1955.

New Promise in Gamma Rays As a Petroleum Processing Tool

GAMMA rays and possibly other forms of atomic radiation may become major tools for petroleum and petrochemical processing in the near future.*

Esso Research and Engineering Co. has been experimenting since early summer in their new radiation laboratory (for details of laboratory see "Atomic Energy a Process Tool," PETROLEUM PROCESSING, Jan. 1955, pp. 43-6). Experiments—as recently reported by the Esso radiation laboratory—have ranged from simple exposures of hydrocarbon samples to gamma rays, to running full-scale refining operations in a 2 quart/day pilot plant—a miniature of a complete refining unit.

Purpose of work is to learn how atomic radiation fits into the picture with temperature, pressure and catalyst as an influence on chemical reactions.

Tests have been made using gamma rays on processes for gasoline, heating oils and petrochemicals. It is hoped to get better quality, lower costs, and perhaps products that cannot be made by conventional "non-atomic" processing.

Esso's experiments show promise for atomic radiation—gamma rays and neutron bombardment—in (1) polymerization of light liquids, (2) degradation of polymers as sources of chemical raw materials, (3) improving gasoline yields, and (4) converting petroleum sulfur compounds into phosphorus compounds.

Petrochemicals, especially polymers, appear most attractive for further study in atomic processing techniques. Applications for lube oils and plastics are being investigated. Esso demonstrated the polymeriza-

tion of liquid methyl methacrylate into a solid by an hour's exposure to gamma rays.

Polymers, such as butyl rubber, can be broken down to give raw materials for making other petrochemical derived intermediates. Thermal cracking of petroleum fractions is speeded by gamma radiation, giving increased gasoline yields.

Most unusual, however, is exposing sulfur-containing hydrocarbons to neutron bombardment in an atomic pile to convert the sulfur atom to phosphorus. Unfortunately, however, the phosphorus is radioactive, and no one knows what problems phosphorus in petroleum will give. —R.L.D.

[1] Anon., "Radiation: Promising New Process Tool," *Petroleum Week*, Dec. 2, 1955, pg. 33.

Studies of Health Hazards Up As Process Complexity Grows

THE petroleum processing industry is stepping up its emphasis on research to reduce potential health hazards. The industry's evolution to a highly complex operation involving both conventional refining and petrochemical manufacture has multiplied the health hazards for employes and consumers who might be in frequent physical contact with petroleum materials.

The increased campaign was keynoted in a report at the American Petroleum Institute meeting in San Francisco in November.[1]

The industry is especially anxious to learn how to spot potential dangers in new products or processes. Some oil company medical departments constantly study the substances made, used or sold by their firms. One company is said to use its medical researchers and industrial hygienists to approve each new equipment design or process as it moves from laboratory to pilot plant to commercial operation.

Toxicity, especially of the chlorinated hydrocarbons, is one thing everyone is concerned about. Another is the possible cancer-producing (carcinogenic) properties of certain petroleum fractions. At the API's San Francisco meeting the Medical Advisory Committee reported some of its accomplishments with this problem. The question was first raised by British experience with occupational skin cancer some years ago and by the appearance of a few cases among petroleum workers in the U.S.

The main conclusion the Committee has been able to draw after 10 years of study is that "experience in refineries has shown that the risk (of contracting skin cancer) is so slight as to be almost negligible if it is recognized and if simple precautionary steps are taken."

Research has found that carcinogens may exist in most crude oils and perhaps even be concentrated in the high boiling fractions by distillation. Further, it is suspected that cracking processes form new carcinogens. But a precaution as simple as washing the skin with soap and water after each shift was found to be sufficient to eliminate the danger of cancer. This last point was established after intensive experiment with mice.

For the future, the Committee is supporting research at the University of Cincinnati to develop an analytical tool for assessing the cancer-producing potential of petroleum hydrocarbons.

The Committee is also sponsoring research projects on the toxicology of fluorides, the toxicity of C_9-C_{12} aromatics, dermatitis, and basic skin physiology.

A year ago the Committee's status was changed. Previously it reported to the Safety Committee of the Refining Division. Now it is supervised and guided by a new body, the Medical Health Committee. All this is evidence of a new eagerness in the industry to keep hygiene in step with technology. —V.B.G.

(1) "The Activities of the Medical Advisory Committee of the API," George M. Saunders, M.D., Socony Mobil Oil Co., Inc., New York, Chairman API Medical Advisory Committee, before Medical and Health Group Session, 35th Annual Meeting, American Petroleum Institute, San Francisco, Nov. 14, 1955.

Long-term Picture for Additives For Automotive Use Is Puzzler

THE comparatively certain future of the gas turbine powered automobile—expected during the next five to ten years in reasonably large volume—has created a potential impact on the field of automotive chemicals.

This field, comprising to a great extent the petrochemicals, is mainly that embracing additives of all types. It includes additives for gasoline, for lubricating oil, and for transmissions. Also affected would be the anti-freeze materials used in cars of conventional design.

The growth picture looks good for the immediate future for these materials, according to a recent account of a special report made by W. E. Kuhn and J. W. Hutcheson for The Texas Co.[1]

After that, however, the market would be almost certain to drop off. Gas turbine-powered autos are not expected to require premium-grade (high octane) fuels with anti-knock compounds. Motor oil demands will be small, and thus lube oil additive needs will be low. The elimination of radiators will cut out the anti-freeze markets.

Additives are not necessarily completely out, however. For one thing, industries outside of the automotive are expected to be increasing their requirements for special lubricants, many of which will have to be tailor-made and include additives.

Also, it is entirely possible that the turbine engine itself will have undergone a number of important design changes—just like its predecessor, the piston engine. And with such changes in design—again, just like the piston engine—will come new and different concepts in fuel specifications which could mean in turn another new additive market.

Big question of course is: what kinds of additives would these be? And the fellow who knows the answer to that one not only goes to the head of the class: he becomes the one with the "better mouse trap." —W.C.U.

(1) "On a Raceway toward Oblivion?" *Chemical Week*, Nov. 12, 1955, pg. 95.

Another amazing case history

WITH *Nalco*

CORROSION AND FOULING

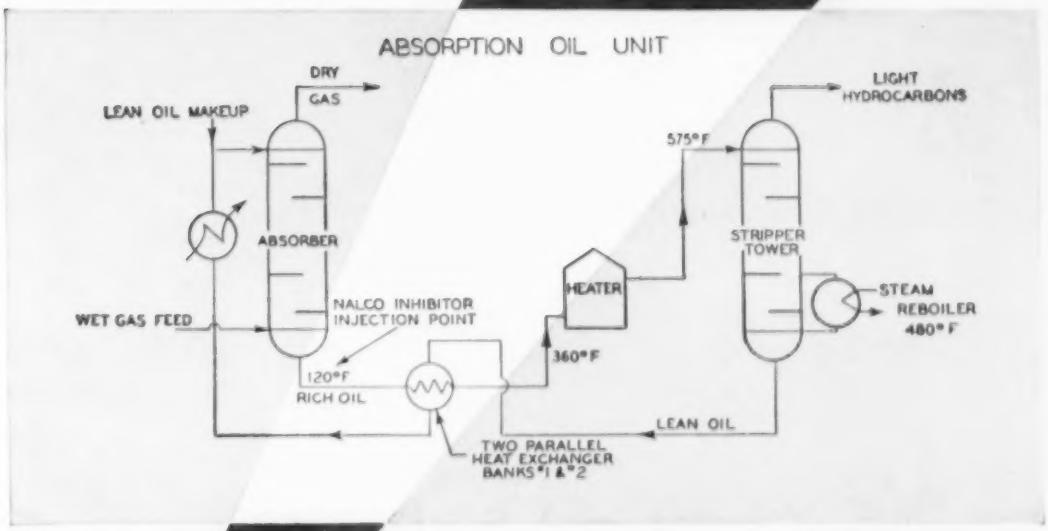
INHIBITORS

THE PROBLEM:

Severe fouling of heat exchangers in a cat cracker absorption oil system where temperatures range up to 575 F.

THE TREATMENT:

Nalco Inhibitor added at 20 parts per million to the absorption oil in the system.



THE RESULT:

Pressure drop across exchanger banks reduced from an average of 95 psi to an average of 12 psi by the detergent-dispersant action of Nalco Inhibitor. And for the first time in plant history, the exchanger banks required *no manual cleaning* after months of operation.

There's more to the story, too—because Nalco Inhibitors were then tried in another absorption system, and performed so successfully they are now used at a number of other locations within the refinery. If yours is a similar problem of fouling, corrosion or hydrogen blistering, it will certainly pay you to look into these amazing Nalco Inhibitors. Talk it over with your Nalco Representative or write direct.

NATIONAL ALUMINATE CORPORATION

6258 West 66th Place • Chicago 38, Illinois

In Canada: Alchem Limited, Burlington, Ontario

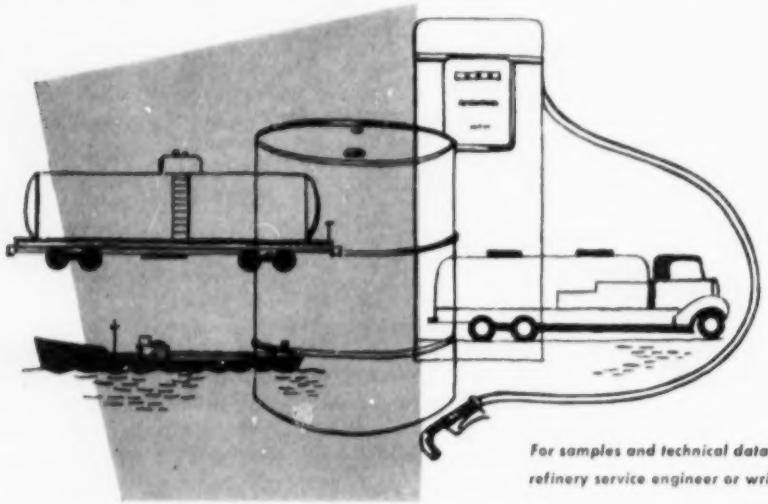
THE *Nalco*® **SYSTEM . . . Serving Industry through Practical Applied Science**

KUPLEX
METAL DEACTIVATOR

A New Tretolite Company product

Copper contamination of refined products can result from as little as 0.028 mg. of copper per gallon. Copper contamination often results from copper treating, but flow through copper or copper alloy equipment also can result in potentially harmful contamination. Further sources of contamination, pipelines, pumps, tubing and fittings can contribute to copper contamination even after the hydrocarbon product has left the refinery for distribution. Kuplex offers the refiner a method of product quality protection at a minimum cost. Kuplex nullifies, by a chelating action, the catalytic degenerative oxidation caused by copper in hydrocarbons. Especially applicable to gasoline, Kuplex is also effective in hydrocarbon streams such as kerosine, jet fuel, diesel and burning oil, turbine oil and greases.

INSURES BETTER, MORE STABLE REFINED PRODUCTS



For samples and technical data, ask your Tretolite refinery service engineer or write to

TRETOLITE COMPANY

A DIVISION OF PETROLITE CORPORATION

369 Marshall Avenue, St. Louis 19, Missouri
5515 Telegraph Road, Los Angeles 22, California

Chemicals and Services for the Petroleum Industry

DESALTING • DEMULSIFYING • CORROSION PREVENTIVES • SCALE INHIBITING ASPHALT ADDITIVES • FUEL OIL ADDITIVES • WATER DE-OILING • PARAFFIN REMOVAL • PRODUCTION STIMULATION • BACTERICIDES • METAL CONDITIONERS

KU-3

Here's Why You'll Want a Copy of the

NEW GMXD COMPRESSOR BULLETIN

If you have a stake in compressor operation, or are interested in learning more about the latest developments in compressor efficiency and economy in the 265 to 660 horsepower range, merely complete and mail the coupon below. You'll receive the brand new Cooper-Bessemer GMXD bulletin.

This 20-page bulletin describes the latest cost-cutting developments in V-angle engine-driven compressor design and construction — developments that mean improved fuel economy, greater capacity and broader practical application.

Other features of the bulletin include detailed cross-sectional diagrams, space plans, typical installations, specifications, operational advantages, and complete information on GMXD *packaged* units.

Learn for yourself how these Cooper-Bessemer advantages are paying off in field gathering, in refineries, and petrochemical operations. Request your copy today.

MOUNT VERNON, OHIO

COOPER-BESSEMER

GROVE CITY, PENNA.

New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

3

The Cooper-Bessemer Corporation
Mount Vernon, Ohio

Please send me Bulletin No. 76 describing the Cooper-Bessemer Type GMXD Compressor Unit.

Name _____ Position _____

Company _____

Address _____

City _____ Zone _____ State _____

In water conditioning...

the tough jobs

go to

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

W. H. & L. D. BETZ, Philadelphia, Pa.

PETROLEUM CHEMICALS DIVISION

NEWS

January ★ One of a Series of Interest to the Petroleum Industry ★ 1956

QUESTION BOX

1. WHAT is the "*typical*" American service station operator's reaction to price wars?
(see article at right)
2. WHERE can you look for new program ideas for your next dealer meeting?
(see below)
3. WHOM can you contact for technical service in the Gulf Coast Region?
(see next page)
4. HOW can you prevent *gel-clogged* heating oil lines?
(see next page)

ANOTHER DU PONT MARKETING SERVICE

Wide selection of program aids available for dealer meetings

During recent years, a wide variety of sales promotion aids have been developed by the Du Pont Petroleum Chemicals Division. These are all designed to be readily adaptable by any oil company for use in its own marketing program. And they make ideal program material for dealer meetings.

A new movie, "When the customer says 'KNOCK,'" is one example of the material available. This explains the common causes of knock other than gasoline quality and helps your dealers answer customer complaints in a salesmanlike way. You can follow up this film with a series of cartoon booklets that will help the dealers remember its message.

Another unique film presentation showing dealers how they can easily *sell themselves* is narrated by an animated cash register. And there are flannelboard presentations on gasoline and lubricating oil quality. Chassis dynamometer and single-cylinder engine demonstrations are also included. For special programs, you can even arrange to use the Du Pont fleet of fuel test cars.

For more information on these and other dealer meeting aids, just get in touch with any of our sales offices. Ask for a copy of "Sales Promotional Aids for Dealer Meetings."

WHO is your "typical" dealer... and HOW does he operate?

Many important facts about the man and his business are revealed in Report No. 4 of Du Pont's continuing market survey, "The Service Station Operator"

Thousands of customers form, confirm, or change their opinions of your company every day . . . based on the impressions made by your service station operators. Because of this, a composite, cross-section picture of the average dealer can be valuable to you in formulating dealer policies and sales promotion plans.

"**The Service Station Operator**" is a new Du Pont survey designed to give you a clear, concise picture of the average American dealer . . . his employees, his business, his opinions, his background, his relation to his petroleum products supplier, and his motivations. Three reports on this survey have already been published and made available to marketers by the Du Pont Petroleum Chemicals Division.

They cover (1) such dealer retail functions as station hours, gallonage, credit and mailing lists; (2) dealer knowledge of products, additives, sales assets, and prices; and (3) opinions on dealer meetings, advertising, dealer publications, and sales aids.

Report No. 4

The fourth report in the series, which has just recently come off the press, discusses the dealer's relationship with employees, his income and reactions to price wars, and his interests in dealer association activities.

The statistics included in the report are graphically illustrated with charts and are enlivened by cartoon drawings. This format makes the important points easy to reach, remember, and refer to.

What happens when . . .

For example, how does the average dealer react to a price war in his own marketing area? That is one of the factors influencing your business which is covered in Report No. 4.

Most of the dealers who have experienced price wars, the survey found, encountered them within the past year. What did they do? . . . The biggest percentage of them met the competition by cutting their own prices. A number of them, however, decided to hold out and refused to cut their prices. Other interesting reactions are also tabulated in this survey report.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED *"Dealer Survey"*

What's next?

A fifth report on "The Service Station Operator" survey is due to be published soon. This will be the most significant of the whole series of reports. It will discuss the interrelationships of all the factors covered in previous reports . . . such as how dealer meetings, station hours, price wars, and other variables affect sales volume.

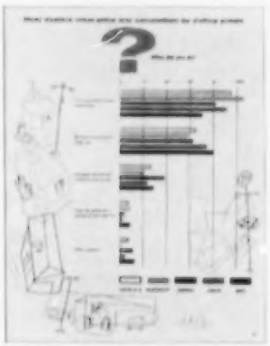
As part of the continuing market research work of the Du Pont Petroleum Chemicals Division, this dealer survey is the natural follow-up of an earlier survey on the buying habits of consumers at service stations. The interviews were conducted on a completely impartial basis by National Analysts, Inc.

Specialized cross-tabulations

Based on personal interviews with 2,633 service station operators – selected by the scientifically accurate area-sampling method – the survey is representative of all the operators in the United States. But the results can be broken down and cross-tabulated to give a true sample of any of four geographical areas.

And in addition to the regular distribution of reports to marketing executives, the entire survey has been tabulated on IBM cards, which will give a wide variety of specialized breakdowns to meet the individual needs of various oil companies.

For more information about this survey, just get in touch with any of our sales offices listed below.



HERE IS a typical page from Report No. 4 on "The Service Station Operator."

GULF COAST REGIONAL LAB MANAGER

John N. C. Cameron, manager of the Du Pont Petroleum Chemicals Division's regional laboratory in Houston, Texas, is in charge of customer service, product testing and additives treating recommendations for Du Pont customers in the Gulf Coast Region.

Before joining the Du Pont Company in 1949, Mr. Cameron was with the Research and Development Division of Humble Oil and Refining Company at Baytown, Texas. During his seven years with this company he worked as a research chemist on octane rating and light oil analytical research. He also did pilot scale research on catalytic treating. Prior to his assignment at Humble, he was employed for three years by the Gravity Meter Exploration Company in Houston.

After starting his college career at the University of Texas, he transferred to the University of Houston, where he received his B.S. degree in chemistry.

Mr. Cameron is a member of the American Chemical Society.

Gel-Clogged Heating Fuel Line!

. . . you can avoid this complaint

A rash of clogged fuel line complaints can quickly jockey you into some rather embarrassing situations. On the other hand, you can easily avoid this kind of trouble before it starts.

If the fuel oil is at fault, the clogging generally occurs in the line leading from the fuel oil storage tank to the burner, or at the screen ahead of the fuel pump. This clogging is generally due to the formation of a *gelatinous* material. And copper or brass are the culprits.

Since the feed-in line and the screen are often made of copper alloys, these are a potential source of copper mercaptides. If formed in sufficient quantities, the mercaptides become gelatinous in nature. So to prevent the clogging you must protect your fuel against the harmful effects of copper.

Here's how . . .

You can help assure adequate protection with DMD (Du Pont Metal Deactivator). It is highly effective in most fuel oil stocks in low concentrations (about 2 pounds per 1000 barrels).

This means that you can, in most cases, insure yourself against the harmful effects of copper–and promote better customer relations, too–at a cost of *less than ½ cent per barrel.*

For best results, it is recommended that you use DMD in combination with Du Pont Fuel Oil Additive No. 2 which guards against sludge.

THIS BOOKLET describes the properties, uses, and methods of addition of DMD. If you do not have a copy, any of our sales offices listed below will be glad to send you one.

DU PONT

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.) *Petroleum Chemicals Division* • *Wilmington 98, Delaware*

Sales Offices:

CHICAGO, ILL.—8 So. Michigan Ave. Phone RAndolph 6-8630
HOUSTON, TEXAS—705 Bank of Commerce Bldg. Phone CApitol 5-1151
LOS ANGELES, CAL.—612 So. Flower St. Phone MAdison 5-1691
NEW YORK, N. Y.—1270 Ave. of the Americas Phone COlumbus 5-2342
PHILADELPHIA, PA.—3 Penn Center Plaza Phone LOcust 8-3531
PITTSBURGH, PA.—Room 510, Alcoa Bldg. Phone ATlantic 1-2933
SAN FRANCISCO, CAL.—Room 626, 111 Sutter St. Phone EXbrook 2-6230
SEATTLE, WASH.—Room 215, 4003 Aurora Ave. Phone MElrose 6977
TULSA, OKLA.—P. O. Box 730 Phone LUther 5-5578

IN CANADA: Du Pont Company of Canada Limited—Petroleum Chemicals Division—80 Richmond Street West—Toronto 1, Ontario
OTHER COUNTRIES: Petroleum Chemicals Export—Nemours Bldg., 6539—Wilmington 98, Delaware

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

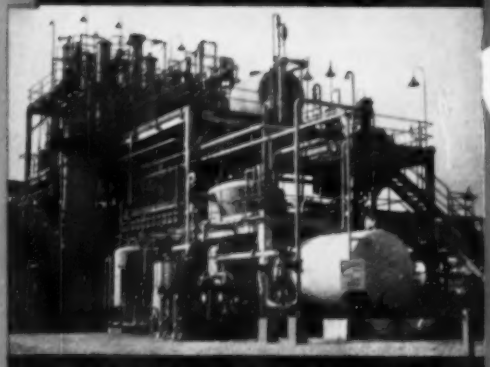
A-633

Printed in U. S. A.

DROP FORGED STEEL

valves, fittings and flanges by Vogt

REFINERIES



CHEMICAL PLANTS

POWER PLANTS

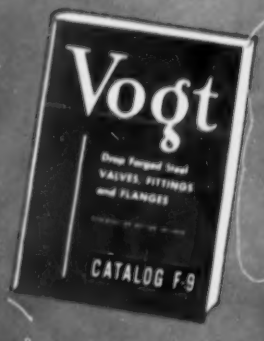
USED and TRUSTED by the NATIONS KEY INDUSTRIES

There are good reasons behind the trust which America's key industries have placed in Vogt valves, fittings, and flanges for half a century. They know that *drop forged materials* are uniform in structure, fine grained, and free from porosity. They know, too, and appreciate the meticulous care given these products through every stage of forging and machining in Vogt's modern shops, and about the many rigid tests and inspections. And that is why these products enjoy such an impressive record of performance in withstanding the shocks and stresses imposed by high or low pressures and temperatures and in resistance to erosive and corrosive conditions.

Service is another important factor in this confidence because Vogt maintains the world's largest and most complete stock of drop forged steel valves, fittings, and flanges always ready for immediate shipment.

Write for Catalog F-9. Consult its 400 pages for the complete Vogt line of drop forged steel valves, fittings, and flanges for oil, steam, water, air, gas, and refrigeration services.

Address Dept. 24-FPP



HENRY VOGT MACHINE CO., LOUISVILLE, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland
St. Louis, Dallas, Charleston, W. Va., San Francisco

HENRY VOGT MACHINE CO. ... 75th Anniversary LOUISVILLE, KY.

ONLY the Type 13A d/p has these 6 advanced-

- **Positive Overrange Protection** up to full 1500 lb. rating
- **Fully Adjustable Ranges . . .** 0-20″ to 0-80″ and 0-50″ to 0-250″ H_2O differential
- **Automatic Internal Damping** . . . fast, *stable* measurement
- **Simplicity** . . . easiest, lowest cost installation, least maintenance
- **Convenient Zero Adjustment** . . . external — no need to remove weatherproof cover
- **Highest Sustained Accuracy** . . . even under extreme operating and ambient conditions

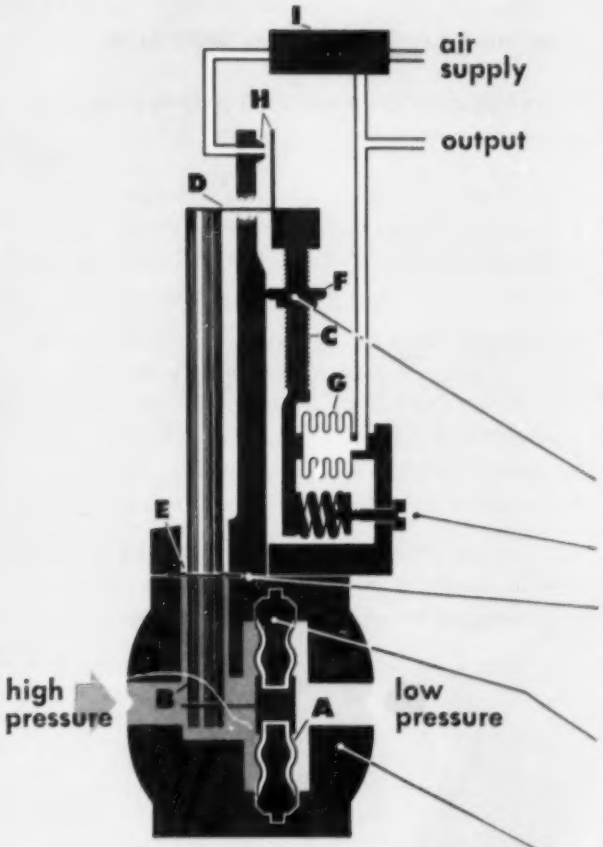
With these basic features, plus many other technical refinements throughout, the new Type 13A d/p Cell® Transmitter surpasses all previous records in performance . . . economy . . . convenience. For the complete story and a demonstration, call your nearest Foxboro representative. Write for new Bulletin 13-11. **The Foxboro Company, 911 Neponset Ave., Foxboro, Mass., U.S.A.** Factories in the United States, Canada and England.

®Reg. U. S. Pat. Off.

More Foxboro flow transmitters are in use by the process industries than all other makes combined!

Cell Flow Transmitter

design features...



How It Works . . .

An increase in differential pressure across Twin-Diaphragm Capsule (A) exerts force to right on force bar (B). Elgiloy® diaphragm seal (E) acts as fulcrum. Force to left at top of bar (B) causes flapper to approach nozzle at (H). Resulting increase in nozzle pressure is amplified by relay (I). This pressure is sent to feedback bellows (G) which develops force to counterbalance the differential pressure on capsule (A). The 3-15 psi output signal from relay (I), always precisely proportional to differential pressure, is transmitted to remote recording or controlling instrument.

Range Wheel is continuously and easily adjustable for entire range whether 0-20" to 0-80" or 0-50" to 0-250" H_2O.

Easy-access screw adjustment permits field "zeroing" without removing weatherproof cover.

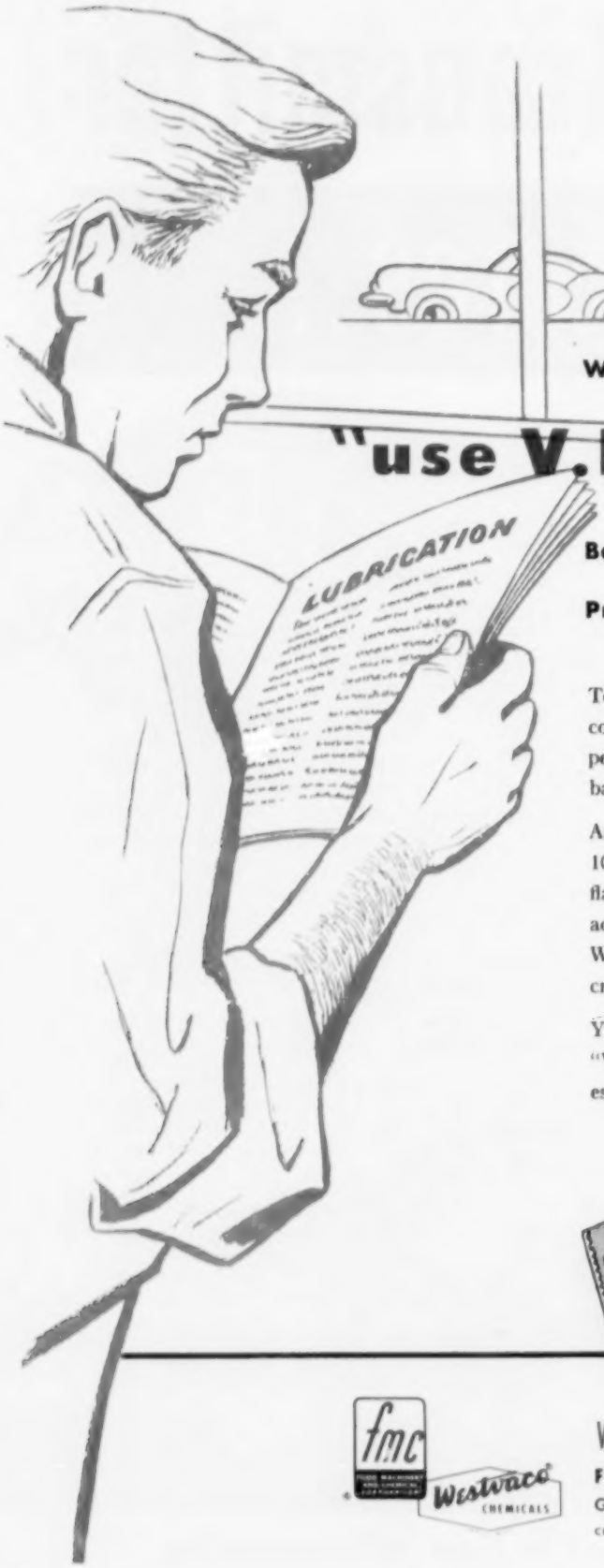
Elgiloy® stainless alloy diaphragm seal assures a corrosion-resistant, frictionless, positive pivot point. Instrument is constructed in 3 basic units — body, transmitter, and air relay block — eliminating all possibility of errors produced by piping stresses.

Silicone-filled Twin-Diaphragm Capsule filters out flow disturbances ("noise") at measurement source . . . without loss of speed of response. Precisely matched surfaces of diaphragms and capsule core provide "stops" which give positive overrange protection in both directions.

Rugged forged body, optionally Type 316 S.S. or carbon steel, gives greatest strength with least weight . . . ultra-compact design permits low cost mounting from flange taps.

FOXBORO
Reg. U.S. Pat. Off.

First in Flow Instrumentation



When The Owner's Manual Says

"use V.H.D. oil only"

Barium-based Additives Will Still Provide an Extra Measure of Protection

Today, 75% of detergent additives are barium based. As compression ratios go up, chances are that an even greater percentage of tomorrow's V.H.D. oils will contain barium-based additives.

Anticipating the trend, we recently increased capacity 100% . . . and stand ready to increase again. We pioneered flake Barium Octahydrate and Barium Pentahydrate . . . advanced forms of soluble barium values now widely used. We also have acquired another large mineral deposit to increase further ore reserves. These efforts continue.

Yes, you can be sure when the owner's manual specifies "V.H.D. Oils Only", we still expect to be America's largest producer of barium alkalis for oil additives.

If you are working with lube oil additives, we would like you to have a copy of this new, 24-page booklet giving complete information on WESTVACO® Barium Chemicals. Send for it now.

fmc Westvaco CHEMICALS

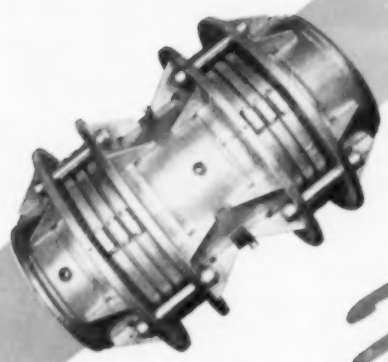
Westvaco Mineral Products Division
FOOD MACHINERY AND CHEMICAL CORPORATION
General Offices • 161 East 42nd Street, New York 17
CHICAGO, ILLINOIS • CINCINNATI, OHIO • HOUSTON, TEXAS • NEWARK, CALIFORNIA

LOOKING FOR AN "ALL PURPOSE" EXPANSION JOINT?

Zallea has never built one—never will. And for good reason. Like all precision engineered equipment, Zallea Expansion Joints are designed to fill specific rigid requirements. In every case, types, sizes and materials of construction are determined by factors of temperature, pressure, traverse and special service conditions.

Zallea Brothers design and build expansion joints for every requirement of modern industry. Field tests have proved the value of our emphasis on designing the expansion joint to fit the problem. Records show that Zallea Expansion Joints outlast all other packless expansion joints from 90% to as much as 1200%. Such reliability is further proof of Zallea design superiority.

Zallea representatives are always ready to help solve problems relating to expansion joints. Or if you prefer, write for Bulletin 351 which describes the many standard types available.

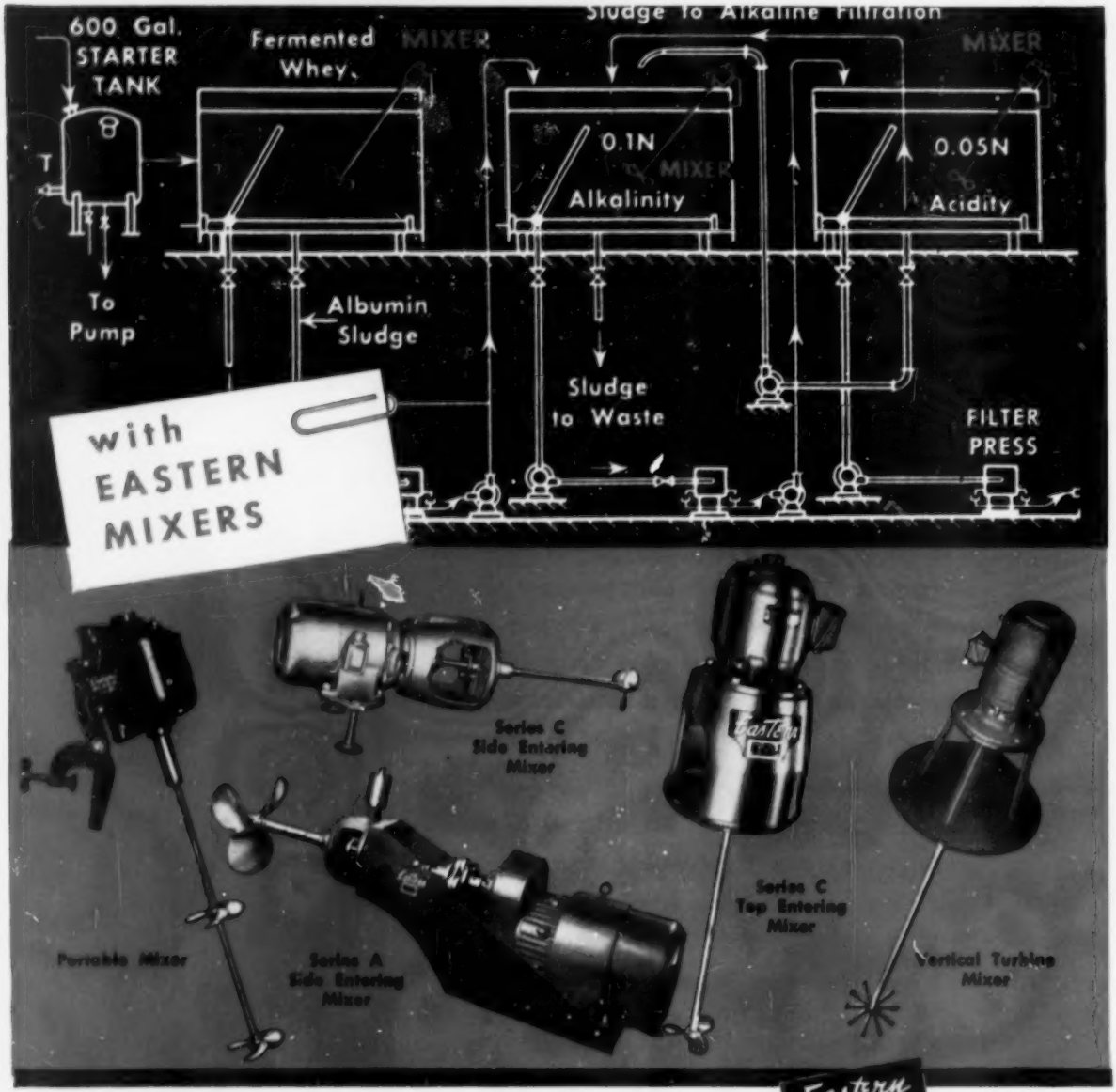


Zallea expansion joints

ZALLEA BROTHERS, 822 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints

RELIABLE FLUID MIXING in PROCESSING



Eastern's Mixers are designed to meet the needs of today's chemical and industrial processes. Many types are available to satisfy all conditions of fluid consistencies and tank sizes. Selection may be made from a wide range of horsepower, speed, and construction materials. Motors with various voltage ratings and enclosures are also furnished.

PORTABLE MIXERS

Series H at 1725 R.P.M., Series S at 1125 R.P.M., and Series G at 420 R.P.M. are available in motor ratings from 1/20 to 5 H.P. Also available are special speeds, variable speeds, as well as air driven models.

TOP AND SIDE ENTERING

Series A, extra heavy duty for large tanks, are available in side entering units only within a range of 5-30 H.P. with standard speeds of 280, 420, and 1150 R.P.M.

Series C, for average tank capacities, are available in sizes of ¼ to 10 H.P. at these standard speeds: 1725 R.P.M. (up to 5 H.P.); 1140 R.P.M. (up to 10 H.P.); 420 R.P.M. (up to 7½ H.P.); 280 R.P.M. (up to 5 H.P.). Available in both horizontal and vertical models.

TURBINE MIXERS

Eastern's Top and Bottom Entering Turbine Mixers find particular application where liquid blending requires gentle, yet thorough agitation.

Models are available in sizes from ¼ to 40 H.P. Standard speeds are 56, 68, 84, 100, 125, 155 R.P.M.

For 3 bulletins covering Eastern Mixers, request Catalog Series 29.

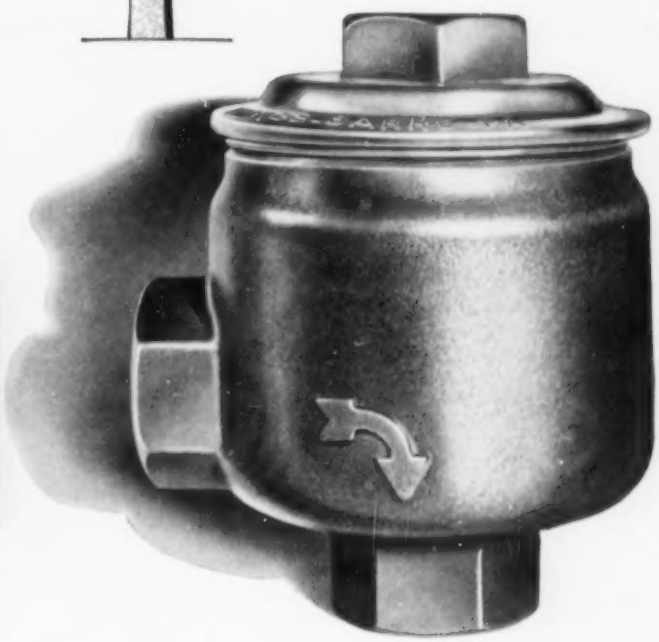
Eastern
INDUSTRIES, INC.
Mixer Division
Regent St., Norwalk, Conn.

(To obtain more data on advertised products see page 126)

TALK ABOUT

Capacity

Discharge orifice of 1" NICHOLSON trap (A) compared with other types of same size (B). Nicholson's greater—in every size!



Compare capacity of a Nicholson Steam Trap with any other trap of same size. Greater capacity—right across the board—means Nicholson Industrial Traps discharge condensate and air from steam lines and process equipment *faster*, more *effectively*. In toughest petroleum processing service, Nicholson's pay off 4 ways:

- **lower initial cost—more for the money**
- **less upkeep expense—minor maintenance**
- **faster warmup—high, even temperatures**
- **faster production—increased 20% to 30%**

Where performance counts, specify Nicholson. Write for *Catalog 953*.

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 58 PRINCIPAL CITIES

Motor oils compounded with ORONITE ADDITIVES

give your customers what they want

Reduced engine wear. Your customers are aware of the greater demands placed on motor oils by the modern, high-compression engine. And with superior oil performance and engine protection provided by Oronite lube oil additives, you can gain a better sales position with your finished oils. With Oronite additives you can prove "reduced engine wear" to your customers.

Oronite's flexible program of custom-formulation to your base oil and individual needs can provide your customers with an exclusive, tailored-to-order motor oil. Why not talk it over with an Oronite lube oil additive specialist. Contact the Oronite office nearest you.

Custom-formulation for individual oil marketer —an Oronite specialty!

ORONITE CHEMICAL COMPANY

ORONITE CHEMICAL COMPANY

200 Bush Street, San Francisco 20, California
30 Rockefeller Plaza, New York 20, New York
20 North Wacker Drive, Chicago 6, Illinois
714 W. Olympic Blvd., Los Angeles 15, California
Mercantile Securities Building, Dallas 1, Texas
Carew Tower, Cincinnati 2, Ohio

(To obtain more data on advertised products see page 126)

New pink insulation boosts Kaylo temperature range 600°F.!

Kaylo®—king of high-temperature insulations—adds a new jewel to its crown . . . a complete line of *pink* Kaylo-*20* insulation serving the extremely high-temperature ranges from 1200°F. to 1800°F.! New Kaylo-*20* is designed for all extra-high temperature applications including catalytic cracking units, refractory wall backing for furnaces and boilers, and fireproofing of piping, equipment, and vessel skirts.

For the first time, Kaylo-*20* brings to these high-temperature installations all the qualities that made regular Kaylo famous—*stability* (Kaylo-*20* will not disintegrate even in boiling water) . . . *ease of application* (cut, saw or score it on the job with ordinary hand tools) . . . *light weight* (only 11 pounds per cubic foot) . . . *economy* (remove it for line inspection, replace it without waste). Kaylo-*20* shrinkage at top temperatures runs less than 2%!

New Kaylo-*20*—now available in a complete range of thicknesses for iron pipe and copper tubing sizes from ⅛" to 39", and in blocks and beveled lags up to 18" x 36" x 3" thick—is distributed by Owens-Corning Fiberglas Corporation. With the other Fiberglas* industrial insulations, Kaylo-*20* completes the most versatile family of plant insulations available. See *Sweet's File, Chemical Engineering Catalog*, or *Refinery Catalog*. Or write: Owens-Corning Fiberglas Corporation, Dept. 185-A, Toledo 1, Ohio.

KAYLO and FIBERGLAS—from one reliable supplier—now provide complete insulation coverage from lowest sub-zero to 1800°F.

OWENS-CORNING
FIBERGLAS

*T.M. Reg. Owens-Corning Fiberglas Corporation
® T.M. Reg. Owens-Illinois Glass Co., Inc., mfr. of Kaylo

 (To obtain more data on advertised products see page 126)

KELLOGG
Sinclair-Baker
Reforming

Dark Horse in the Reformate Race...

New Process and New Catalyst Promise New Records in Production of Low Cost, High Octane Reformates

Although the M.W. Kellogg, Sinclair-Baker process is still too new in service to provide any long-term performance data, and customers' initial findings cannot yet be disclosed, many economic advantages of this catalytic naphtha reforming process have already been firmly established. Any refiner faced with increasing octane yields from present feedstocks, or with getting high octane reformates from lower grade naphthas, will recognize the significance of the following points . . .

Quick Start-Up

Experimental operation is reduced to a minimum. One M. W. Kellogg reforming unit was started on its final test run within two weeks after the catalyst was first charged to the reactors—with octane rating and yield during this 15-day period well in excess of the guarantee.

A Regenerative Catalyst

Sinclair-Baker Platinum Catalyst RD-150 can be regenerated easily and quickly *in situ* to provide many operating cycles, each of many months duration, with negligible loss in catalyst activity. Cost of catalyst per pound in terms of barrels of reformate produced is a major economic factor of the process.

Long Catalyst Life

Sinclair-Baker regenerative catalyst RD-150 has high activity and long initial life. It has been in operation for over one year without supplementing the catalyst. 95 octane reformate can be produced for six months or longer before regeneration is required.

Octane Level

Depending on the feedstock, clear octane ratings above 90 are now being obtained commercially—with 100, and even better, a goal that is entirely feasible and economically practical. *Variability* of octane rating is the keynote of the process, permitting selection of the exact processing conditions for a given naphtha to secure optimum economic operation at all times.

Supply of Catalyst

Use of the process does not obligate refiners to buy Catalyst RD-150 beyond the first year's requirements, although a continuing source of supply can be assured. This freedom from long-term purchase and license agreements is an important consideration when deciding which is the most suitable reforming process.

Low Grade Naphtha Feeds

M. W. Kellogg's unique design permits the effective desulphurization of low grade naphthas as part of the process, and avoids corrosion and metal contamination. Kuwait naphthas thus treated, for example, can produce yields of high octane reformates only slightly lower than those for higher grade Mid-Continent feedstocks.

For More Information

Further details on M. W. Kellogg's catalytic naphtha reforming process, the Sinclair-Baker catalyst, together with some economics of both, are contained in a recent booklet, "Low Cost Production of 95 Octane Clear Reformate." Copy sent on request.

Refinery Process Division

THE M. W. KELLOGG COMPANY

225 Broadway, New York 7, N. Y.

The Canadian Kellogg Company, Ltd., Toronto • Kellogg International Corp., London

SUBSIDIARIES OF PULLMAN INCORPORATED

Advanced Design

for today's pressure storage

Reminiscent of the Trylon and Perisphere this 5,000-bbl. Hortonsphere® and 1,000-bbl. blimp is not futuristic planning but advanced design applied to today's volatile hydrocarbon storage. The structures shown are used for pipeline surge and storage vessels.

Hortonspheres and blimps prevent evaporation and quality loss of volatile liquids by utilizing the fact that no vapor can escape or air enter as long as pressure does not exceed the pressure relief valves. With the exception of the relief valves and gages there are no moving parts.

For further information, estimates or quotations, write our nearest office.

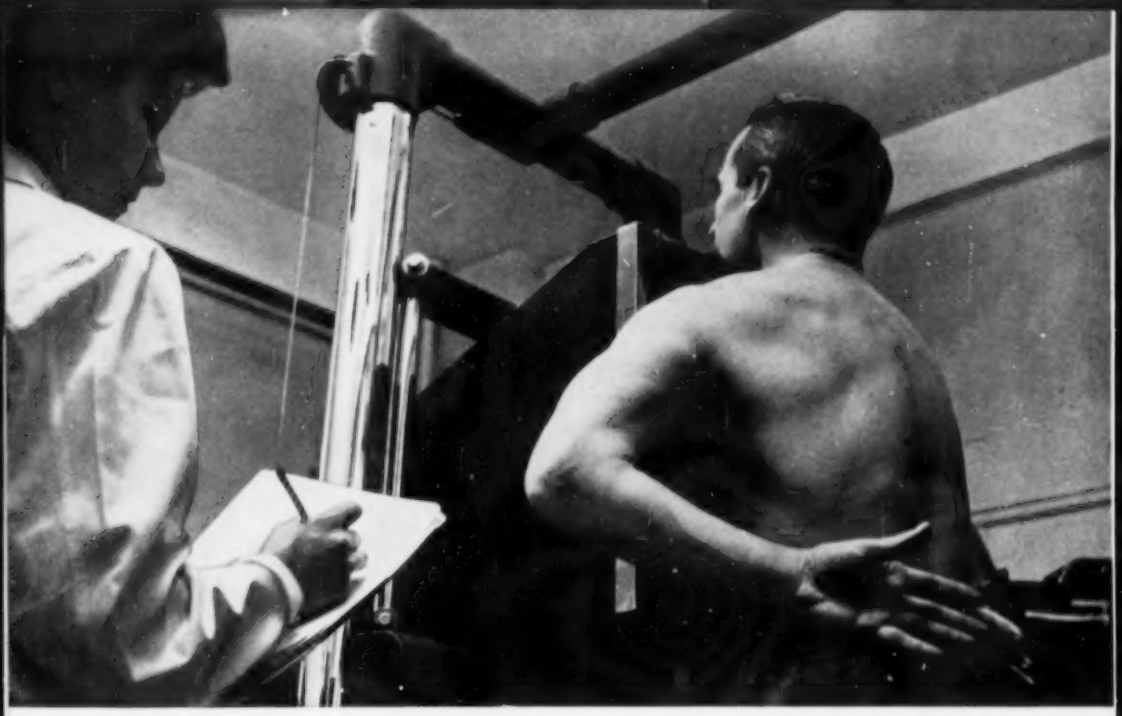
CB&I

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston • Los Angeles • New York
Philadelphia • Pittsburgh • Salt Lake City • San Francisco • Seattle • Tulsa • Washington

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

REPRESENTATIVES AND LICENSEES: Brazil • Canada • England • France • Italy • Netherlands • Scotland • Venezuela



GENERAL REFRACTORIES

better health . . . because of BRICK

It is hard to associate X-rays with brick—the refractory brick which contains the fires of industry. Yet, were it not for brick these fine X-ray machines would never be made, and there'd be no electricity to operate them.

From an autoclave to an automobile, from a scalpel to a skyscraper, everything that's made and every form of transportation, communication and power owe their existence to refractory brick.

Our job is to provide that brick. In infinite variety. Compounded to formulas as precise as a prescription, in the world's largest refractories research laboratory. Moulded from materials brought from many countries in plants strategically located across our country to serve industry swiftly . . . dependably . . . economically . . . everywhere.

GENERAL REFRACTORIES COMPANY
Philadelphia 2

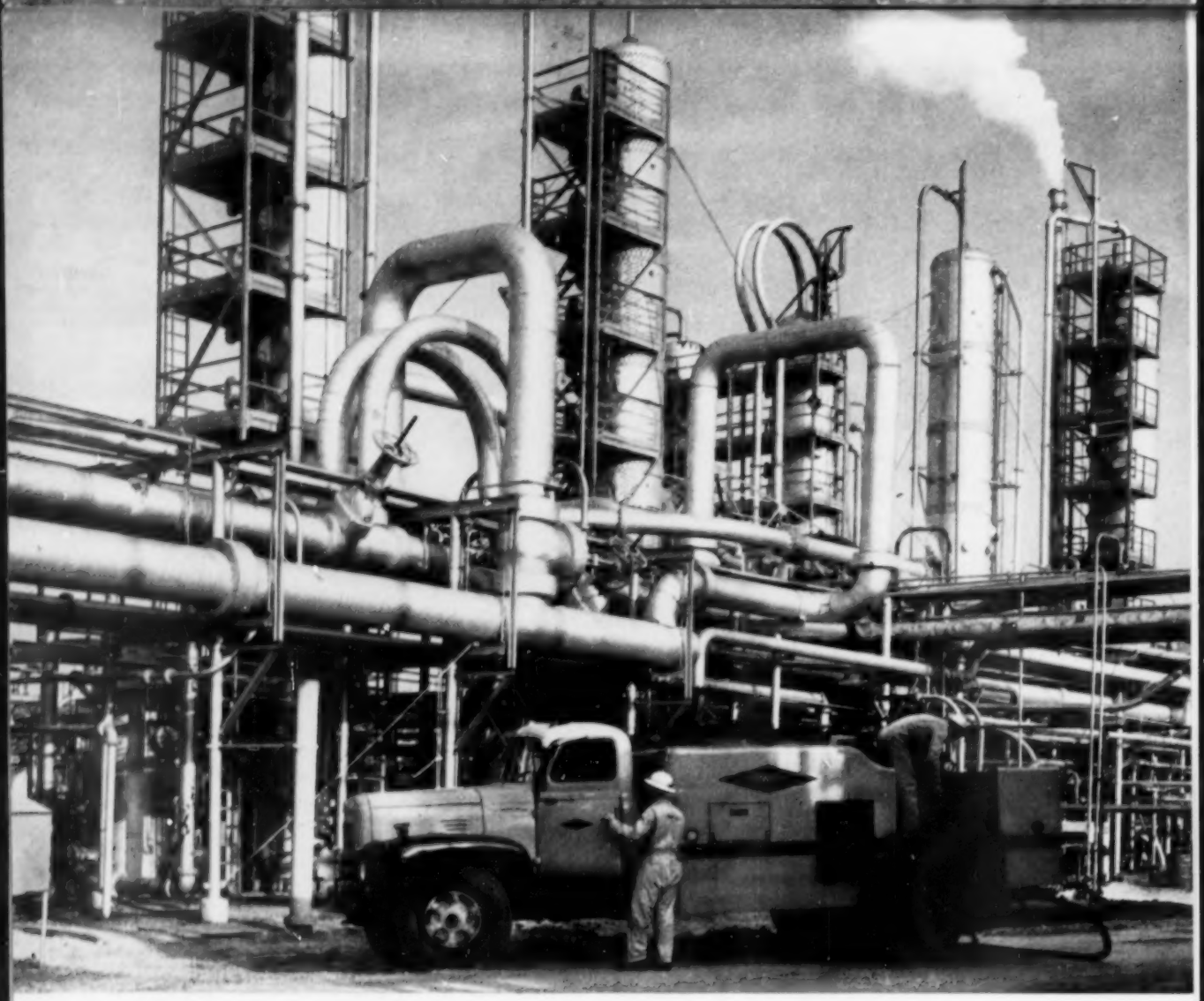
A COMPLETE REFRACTORIES SERVICE FOR THE PETROLEUM INDUSTRY

LITECAST 50—A hydraulic-setting insulating castable refractory material, having a density of approximately 50 lbs. per cubic foot. Its extreme light weight and exceptionally low thermal conductivity make it an efficient and economical heat insulator. Recommended for vessel linings and backing for brickwork for other heavier castable refractory materials.

HIGH-STRENGTH BRIK-CAST—A hydraulic-setting castable refractory material unique in that it contains more bonding agent, which results in a product more resistant to the physical actions of impact, erosion, and load bearing. Used extensively for lining regenerator chambers and catalyst lines in catalytic cracking units.

LITECAST 50-M—A 50-pound density insulating castable, having a high degree of purity, used as a liner in vessels and lines where atmospheres must be controlled, or contamination of internals must be avoided. LITECAST 50-M may be applied in the same manner as standard hydraulic-setting castables.

BRIK-CAST 3000—A hydraulic-setting castable refractory material, composed of clays and bonding agents having the highest purity, resulting in a product with a high operating temperature (3000° F.), and resistance to reducing atmosphere in carbon monoxide attack. Recommended for sulphur burner chambers and other vessels operating above normal cracking and reforming temperatures.



SIX DAYS OF DOWNTIME SAVED

Refinery tower cleaned chemically by Dowell in only eight hours . . . a six-day saving over mechanical methods!

A refinery operator had to shut down his H_2S stripper bubble cap tower every two months to remove an oily carbonate scale. Each shutdown took seven days, because of the mechanical cleaning methods used, and even then the tower was not thoroughly cleaned.

Dowell engineers were asked to tackle the problem. They cleaned the tower in just eight hours, using chemical solvents. Visual inspection showed the tower to be free of scale with all loose deposits washed from the caps and trays. The operator of this refinery was so impressed that he adopted a regular schedule of Dowell chemical cleaning.

Dowell chemical cleaning methods are designed to reduce costly downtime, because solvents are introduced through regular connections, keeping dismantling at a minimum. Liquid solvents can go wherever gases or condensates flow —to clean angles, bends and other irregular surfaces inaccessible to mechanical methods.

You can help to maintain maximum operating efficiency in your plant by arranging for a regular program of Dowell chemical cleaning. For full information, call your nearest Dowell office, or write Dowell Incorporated, Tulsa 1, Oklahoma, Department A-32.

chemical cleaning service for industry

DOWELL

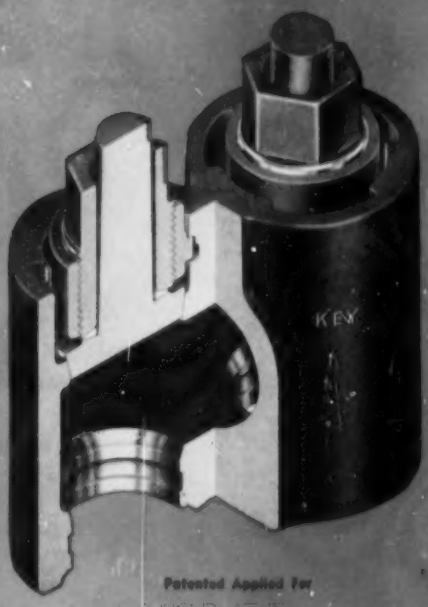
A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

STANDARDIZE ON THIS FITTING AND YOU'LL REDUCE INVENTORY...SAVE MONEY...

it's the NEW 5000 TYPE KEY® RETURN BEND FITTING

WITH HIGH DEGREE OF INTERCHANGEABILITY

TWO SERIES:
850 and 1275 LBS.
NINE FITTINGS
in each series



Patented Applied For

A TOTAL OF 18 FITTINGS, BUT REQUIRING ONLY 26 PARTS INSTEAD OF 72

HEADING UP OPERATION
Holding member and screw may be handled as a unit.

UNHEADING
A slight loosening of the screw permits holding member and screw to be removed as a unit. The stem has been designed to withstand plug removal by striking with a hammer.

SAFETY FEATURE
Plug can be loosened before a holding member is disengaged, preventing the possibility of the plug blowing out of fitting as the result of build up of back pressure.

DAMAGED PARTS
If threads become damaged or frozen, holding mechanism can be removed by turning the breech.

STRESS DISTRIBUTION
Elliptical crossovers in the 5000-type give a maximum uniform distribution of stress. Plug hole section will be more uniformly stressed because of the added support of the 360° projection immediately above the plug seat.

METAL IN TENSION
The tension load is evenly distributed throughout the 360° circular projection.

SHEAR
The shear load is evenly distributed over 180°.

BENDING
No bending can occur in the holding member and the full 360° projection above the plug seat prevents bending of the lugs.

850 lb. and 1275 lb. series

Fitting Size	Plug Number	Holding Member Number	Screw Number	Thrust Ring Number
2½	8Y1	2Y1	9Y1	D-13011
3	8Y2	2Y2	9Y2	D-13012
3½	8Y3	2Y3		
4	8Y4	2Y4		
4½	8Y5	2Y5	9Y3	D-13013
5	8Y6	2Y6		
5½	8Y7	2Y7		
6	8Y8	2Y8	9Y4	D-9356
6½	8Y9	2Y9		

All parts of the 5000-type fitting, exclusive of the body casting, are available for immediate shipment from stock.

Write for information and prices now

key company

SINCE 1916 . . . MANUFACTURERS AND DEVELOPERS OF PRODUCTS FOR HIGH TEMPERATURES AND PRESSURES

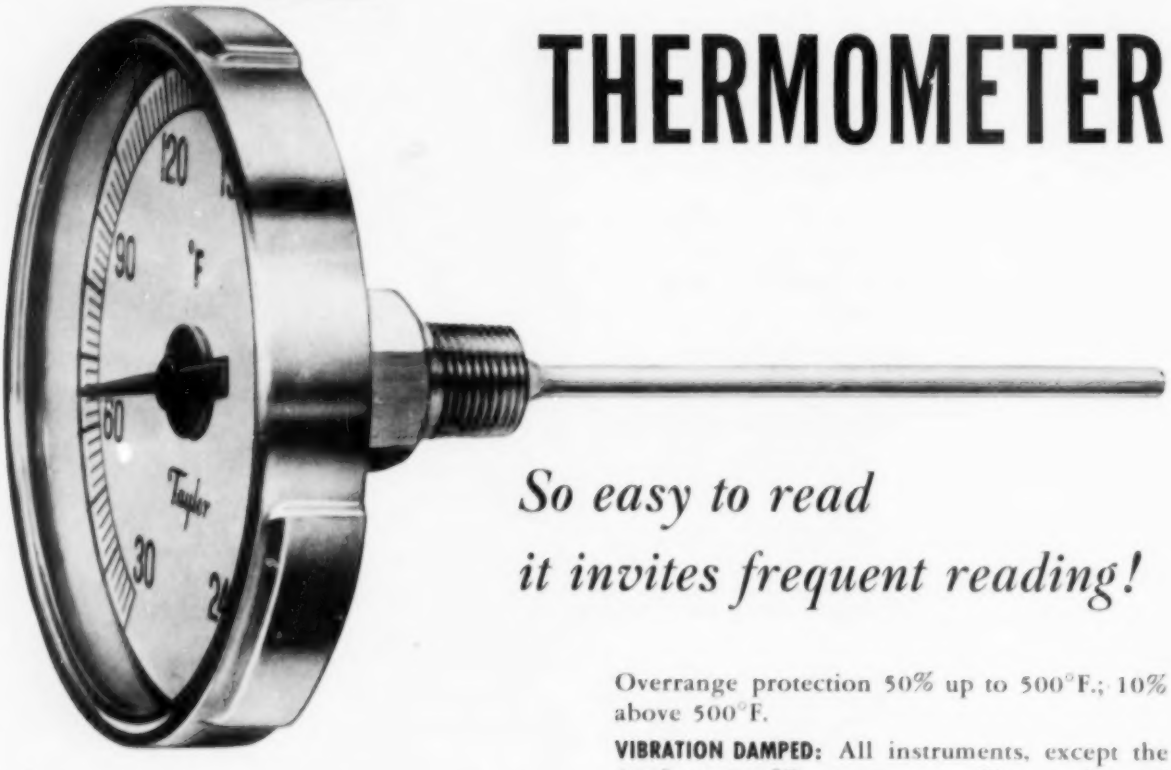
P.O. BOX 494-N EAST ST. LOUIS, ILL.

A DIVISION OF O.C.F. INDUSTRIES INCORPORATED

DISTRICT OFFICES: NEW YORK • CLEVELAND • CHICAGO • TULSA • HOUSTON • LOS ANGELES

Traditional Taylor accuracy in a low cost instrument

THE NEW BI-THERM* 5" DIAL THERMOMETER



So easy to read
it invites frequent reading!

A SIMPLE, dependable and economical thermometer with many applications throughout the petroleum field, such as, Heat Exchangers, Pipe Lines, Storage Tanks, Field Treaters. Wide variety of ranges from minus 40° to +750°F. Also available with three inch dial; stem lengths of 4, 6, 9, and 12 inches; separable wells of brass, steel, type 304 stainless steel or monel.

EASY TO READ: The large dials are highly readable because of black figures and graduations on an aluminum background.

RUGGED: All exposed metal parts are of arc welded, corrosion-resistant stainless steel. All instruments are waterproof. All mechanical connections are welded for greater reliability.

ACCURATE: These instruments are accurate within ±1% of range, over the entire range. Simple zero-setting features correct minor errors in readings which might result from severe mechanical shock. No ambient temperature effect. Overrange protection 50% up to 500°F.; 10% above 500°F.

VIBRATION DAMPED: All instruments, except the 200° to 750°F. range, are silicone damped against vibrations. Result is increased speed of response, no zero-shift due to shock, minimum pointer vibration, and elimination of pointer chatter when the thermometer is handled.

ECONOMICAL: Costs only **$16** to **$26,** depending on dial size and length of stem. Ask your Taylor Field Engineer, or write for **Bulletin 98267.** Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

*Trade Mark

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

HERE'S WHAT WOLVERINE TRUFIN* WILL DO FOR YOU . . .

TRUFIN*

- STEPS UP HEAT TRANSFER EFFICIENCY
- SAVES TIME
- SAVES MONEY
- SAVES VALUABLE SPACE

Yes, if you want more heat transfer efficiency—want to save time, money and space—here's a tip for you. Investigate, today, the possibilities of Wolverine Trufin Type S/T condenser tube.

Type S/T is an extended surface condenser tube. Its extruded fins—providing greater heat transfer surface—are actually part of the tube wall. A ¾ inch Type S/T condenser tube, for example, has an external-to-internal surface ratio of 3½ to 1. *It has approximately 2½ times the outside surface of the ¾ inch prime surface tube it is designed to replace.* That means increased capacity—more BTU's from every foot of tube.

When an installation tubed with Trufin goes on stream—it stays on stream longer. Because the fins are part of the tube, they can't shake loose from vibration, thermal shock or pressure fluctuations. Actual operating data and pilot plant research indicate that Trufin Type S/T actually resists the deposition of fouling materials. Maintenance costs go down—and stay down. When specified for new units, Trufin Type S/T permits the designing of smaller, more effective heat exchangers and condensers. You save space and you spend fewer dollars.

Type S/T—when specified as replacement tube—packs more heat transfer surface into existing units, steps up capacity far above original output. It can be directly substituted for prime surface tube without any deviation from standard retubing techniques.

And there—in brief—is what Wolverine Trufin Type S/T will do for you. Put it to the test—specify Type S/T—for both new units and when retubing existing units. Wolverine's new Processing Flowsheets Catalog shows exactly where Type S/T is being used and can be used in the industry. Write for your copy—TODAY.

Wolverine Tube, 1441 Central Ave., Detroit 9, Mich.

*REG. U. S. PAT. OFF.

Wolverine Trufin available in Canada through the Unifin Tube Company, London, Ontario.

WOLVERINE TUBE

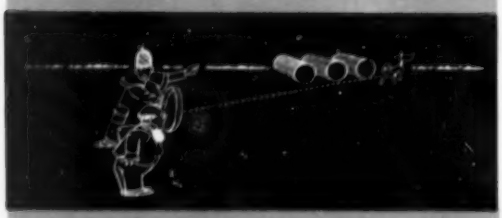
Division of Calumet & Hecla, Inc.

MANUFACTURERS OF QUALITY CONTROLLED COPPER AND EXTRUDED ALUMINUM SHAPES

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES

EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK

THE CASE OF THE KIDNAPPED CONDENSER



"See that vacant space out there—just to the right of those three condensers. It used to be occupied by No. 4 condenser—but not any more. Good old No. 4 is gone—kidnapped by a piece of licorice.

"What's that you say? It sounds like a mystery story with a trick ending. Well, in a way it is. It all started eight months ago when home office began screaming for more production. I'm telling you our whole engineering department sat up nights trying to figure it out. We just couldn't see how we could boost output—short of building a new plant, that is.

"Then we got our first real break. I'm sitting home one night—dead tired—when Johnny, my five-year old son walks in. Is he a mess. He's chewing on a piece of licorice—and it's smeared all over him.

"I start to take it away from him—when something about that licorice rings a bell in my mind. It's the way it looks—sort of like a piece of tube—*with fins!*

"Then it comes to me—something a Wolverine salesman had mentioned one day in my office. 'Wolverine Trufin*,' he said, 'is an extended surface condenser tube with integral helical fins squeezed right from the tube wall. Because of the fins, Trufin has much greater capacity than prime surface tube.'

"That was the clue we were looking for. We pulled a condenser and retubed with Trufin Type S/T. The results were terrific. Right away heat load jumped from 417,000 BTU's per hour to 829,000. You can just bet that No. 2 and No. 3 got the same Trufin treatment. No. 4 got the gate—we just don't need it anymore. You might say that it was kidnapped by Trufin Type S/T—and a piece of licorice."

Next time you retube—specify Wolverine Trufin Type S/T—see how it can solve heat exchange and condensing problems in your plant. Write, too, for the new Trufin Opportunity Book. It's filled with valuable design information and actual Trufin case histories.

Wolverine Tube, 1441 Central Avenue, Detroit 9, Michigan.

*REG. U.S. PAT. OFF.

WOLVERINE TUBE

Division of Calumet & Hecla, Inc.

MANUFACTURERS OF QUALITY CONTROLLED TUBING AND EXTRUDED ALUMINUM SHAPES

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES

EXPORT DEPARTMENT, 15 EAST 40TH STREET, NEW YORK 16, NEW YORK.

America has homework to do!

THERE'S PROBABLY a lot about your town that makes you want to brag a bit about it.

But there's one thing you *can't* be proud of. And it's a shame you share with just about every other community in America.

The homes where far too many people live are a disgrace. Slums, semi-slums, housing blight are with you. Fixing them up is the homework to be done.

If your town is like most in the U. S., here's what the figures show: 1 out of every 10 homes are rock-bottom slums. Nearly one-half urgently need basic repairs.

But slums are something that is happening on the other side of town, you may say. The problem isn't mine.

Slums are YOUR homework

Distance is no barrier against the threat and cost of housing blight.

Your taxes go up because it takes more money for your town to fight the diseases and delinquency and poverty spawned in the slums. The security of your family goes down because the slum is the natural parent of crime.

Where your business comes in

Every firm has a responsibility toward the town where it's located. Part of it is to support community improvements as any other good citizen would.

Some slums are beyond repair. They must be torn down and a fresh start made. Others can be made to conform to accepted living standards. So it is up to you to get behind every sound program which seeks to provide adequate housing for all our people.

Civic and individual groups must have business backing . . . *your* firm's backing if they are to succeed.

Follow the course of Action!

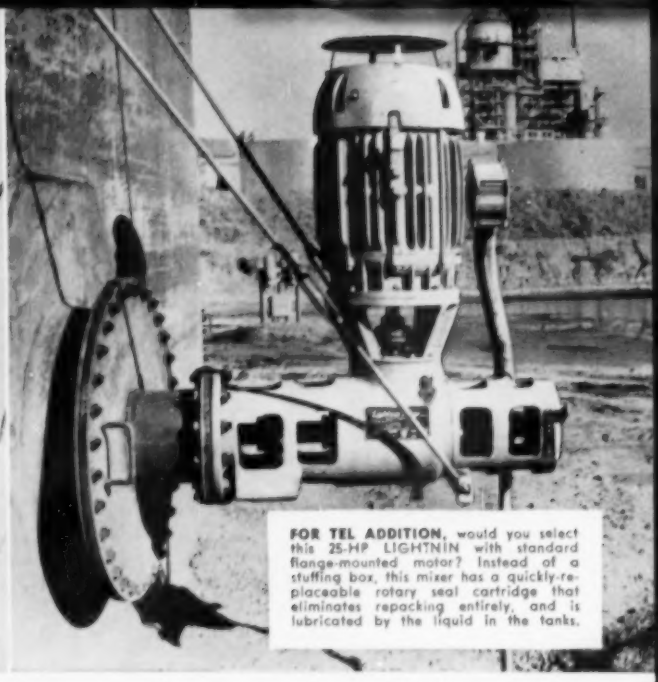
A group of Americans from every walk of life has joined together in a non-profit organization to combat home and community deterioration, A.C.T.I.O.N., the American Council To Improve Our Neighborhoods.

Send today for a free copy of "ACTION." It explains what A.C.T.I.O.N. is and proposes to do. It lists booklets, research, check-lists, and other material which can help you. Address P. O. Box 500, Radio City Station, New York 20, N. Y.

ACTION

American **C**ouncil **T**o **I**mprove **O**ur **N**eighborhoods

FOR BLENDING CRUDE would you choose a unit like this? It's a 25-HP LIGHTNIN, equipped with a standard foot-mounted motor and a packed stuffing box designed for pressures to 150 psig.



FOR TEL ADDITION, would you select this 25-HP LIGHTNIN with standard flange-mounted motor? Instead of a stuffing box, this mixer has a quickly-replaceable rotary seal cartridge that eliminates repacking entirely, and is lubricated by the liquid in the tanks.

How to match any given set *of mixing or blending conditions*

Which mixer would *you* specify for a big blending job?

These pictures show just *two* ways you can buy LIGHTNIN Mixers to suit a specific mixing or blending operation.

There are many, many more ways to do this. For example:

MOTORS. You can order LIGHTNINs with the motor that gives you best service and minimizes your stock requirements: any make with NEMA frame; any current characteristics; any enclosure or insulation.

DRIVES. You can choose a highly efficient gear drive, or a lower-cost V-belt drive, for power input to the mixer. On gear drive LIGHTNINs, you can have a fluid coupling between motor and drive to handle excessively high starting torques.

SHAFT SEALING. You can specify the new rotary seal mentioned above (it's saving many oil companies several thousand dollars a year on maintenance). Or you can have your pick of *four* standard packed stuffing boxes, two of which permit repacking without draining the tank.

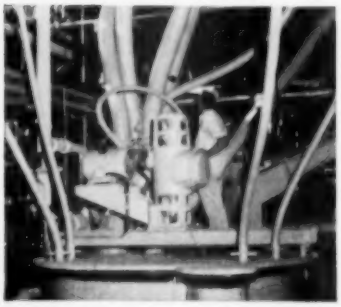
SIZES. You have a full range of sizes to choose from—18 basic models, 1 to 25 HP—so you get a mixer closely fitted to your needs.

MATERIALS. And you can write your own ticket on corrosion-resistant materials for shafts and propellers. You can get these wetted parts in *any* machinable metal or alloy—and with special covering if you want it.

You don't pay more for this freedom of choice. You *save*—because you cut your mixer operating, maintenance, and parts-stocking cost for *as long as the next 20 years.*

That's why it pays to look for the mixer that gives you *most choice* for the money.

Your LIGHTNIN Mixer representative will help you find it—quickly, without obligation. His name is in your copy of Refinery Catalog. Why not call him today?



GET THE ONE correct flow pattern that can give optimum fluid mixing results—with turbine-type LIGHTNINs for open or closed tanks. Hundreds of power-speed combinations are available, in sizes from 1 to 500 HP. Results guaranteed.

OPEN TANK becomes an efficient mixing vessel when you add a LIGHTNIN Mixer. Propeller unit, one of 30 models ranging from ¼ to 3 HP, tumbles and rotates the batch rapidly to achieve uniformity in least possible time.

Get these helpful facts on mixing: cost-cutting ideas on mixer selection; best type of vessel; installation and operating hints; full description of LIGHTNIN Mixers. Free—no obligation. Just check data you want, tear out and mail to us today with your name and company address.

- ☐ B-102 Top Entering Mixers (turbine and paddle types)
- ☐ B-103 Top Entering Mixers (propeller types)
- ☐ B-104 Side Entering Mixers
- ☐ B-107 Mixing Data Sheet
- ☐ B-108 Portable Mixers (electric and air driven)
- ☐ B-110 Condensed Catalog (complete line)
- ☐ B-111 LIGHTNIN Rotary Mechanical Seals
- ☐ B-112 Laboratory Mixers

MIXING EQUIPMENT Co., Inc., 131-a Mt. Read Blvd., Rochester 11, N. Y.
In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 10, Ont.

"Lightnin® Mixers"

MIXCO fluid mixing specialists

Petroleum Processing
JANUARY 1956

What Happened at Whiting?

Report gives some clues to cause, mechanism of explosions in Indiana Standard's Orthoformer

Explosions and fire destroyed the 5-month-old, 25,000 b/d Orthoformer of Standard Oil Co. (Indiana) at Whiting, Ind., on Aug. 27, 1955. Since then, an intensive study has been in progress to determine the cause and mechanism of the explosions.

Although details on the actual fire and events following the explosions appeared in the Oct., 1955, issue of PETROLEUM PROCESSING ("Fire! What Then?", pp. 1559-1569), little information was available at that time on the events which led up to the explosions. This article fills in some of that data.

It is based on a "Report on the Investigation of the Accident to the Whiting Fluid Hydroformer* Unit," prepared by the company's engineers and distributed to the General Committee of the API Division of Refining.

Conclusions on the Cause of the Explosions

INVESTIGATION of the cause of the accident to Indiana Standard's Fluid Hydroformer has progressed to the point where an explanation can be given concerning the nature of the explosions and the manner in which they were initiated. Although the study is not yet complete, it does permit certain conclusions to be drawn:

1—The disaster was caused by explosions occurring within the recycle gas system, and especially those in the reactor and high pressure separator.

2—The explosive forces were of such a nature as to indicate clearly a progressively rapid burning in various parts of the recycling system.

In the case of the reactor, the burning traveled vertically upward and about midway in the vessel developed a "shock wave" of very substantially increased pressure which was of sufficient magnitude to produce fragmentation of the shell and to initiate ejection of the fragments at rather high velocities.

A progressive burning likewise travelled through the high pressure separator from the gas outlet end and developed a high intensity "shock wave" near the opposite end. This end of the vessel was fragmented into a number of pieces which likewise were ejected at high velocity. The balance of the vessel was badly ripped, or torn, but the pressure conditions obviously were not as severe as those at the fragmented end.

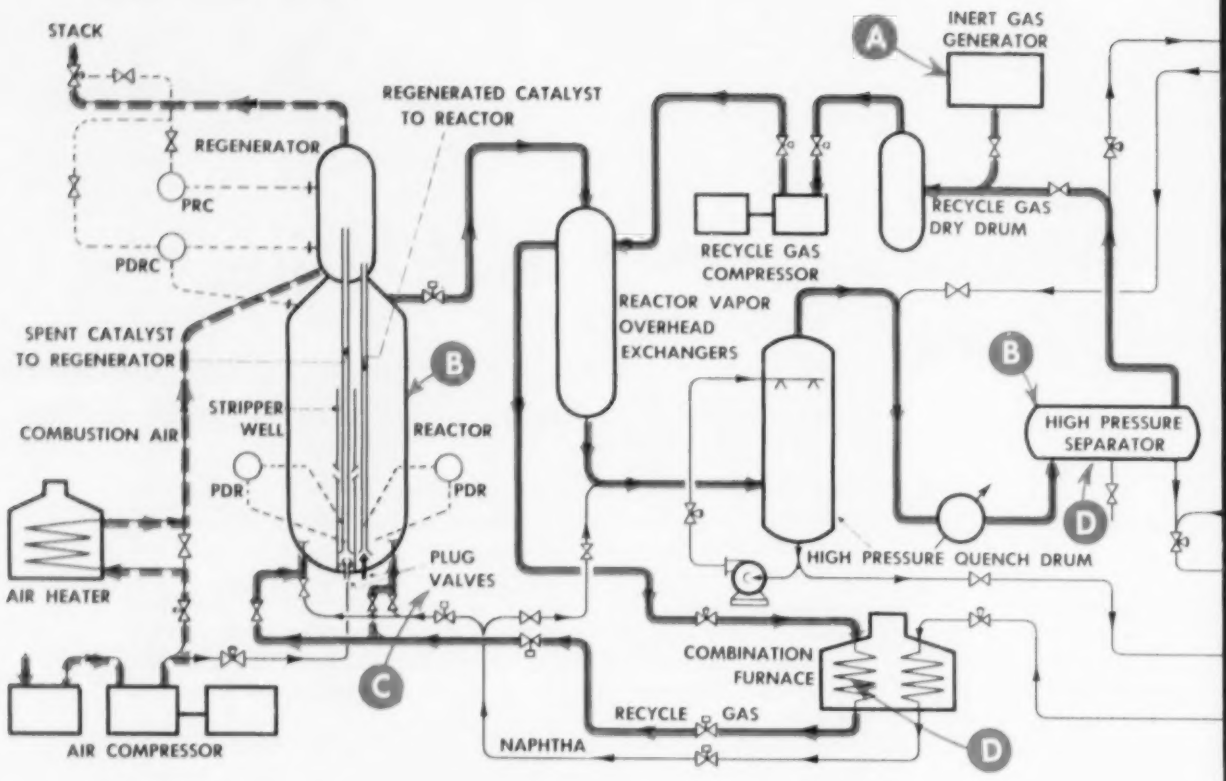
Other vessels in the recycle gas stream show clear evidence of over-pressuring but they did not burst. Piping in the same stream likewise exhibits evidence of over-pressuring and two elbows were fractured. The only part of the recycling system in which no evidence has been found to date of internal explosion is the high pressure quench drum.

3—Prior to the disaster, the vessels, other than the high pressure quench drum, and some piping associated with it, must have contained a mixture of gases comprised of no less than 2% of hydrocarbon and 10% of oxygen. The temperature and other conditions in the high pressure quench drum apparently were unfavorable to the development of an explosion.

4—Sufficient hydrocarbons would be present in the recycle system in the normal start-up procedure to supply the combustible requirement for an explosion. The oxygen requirement, however, must have been acquired by accidental means.

5—Two possible sources of high pressure air existed, which could possibly furnish the necessary oxygen; namely, the inert gas system and the combustion air system. An examination of operating information pertaining to the inert gas system indicates that it supplied some hydrocarbons and oxygen to the recycle gas, but only in relatively small

* Two names have been used to describe the catalytic reforming unit installed at the Whiting refinery. The contractor who designed and built it, M. W. Kellogg Co., identifies it as an "Orthoformer." Indiana Standard itself prefers to call it an "Orthoflow Fluid Hydroformer."



measure. An examination of the conditions pertaining to the recycle gas and combustion air systems indicates that the oxygen supply to the recycle gas was provided by accidental but unrecognized air leakage from the regenerator into the reactor via the catalyst circulating pipes for a period of several hours prior to the explosion.

The evidence further indicates that during this period at least one of the plug valves in the catalyst recirculating piping in the reactor must have been open a substantial amount in order to account for the necessary flow of air between the regenerator and reactor but no evidence is presently available to account for the open position of the valve.

6—Examination of the design of the vessels involved in the explosion, metallurgical examination of the materials used in these vessels, and inspection of the welds reveal that the design, the materials and the workmanship pertaining to the vessels met existing code requirements.

7—The spontaneous ignition temperature of the hydrocarbon-air mixture in the recycling system was comparatively low—probably between 500 and 600° F.

8—The course of ignition has not been established, but at least two possibilities are known—spontaneous ignition in the recycle furnace, and spark ignition from static electricity in the high pressure separator.

9—The turbulent conditions in the recycle gas piping would be sufficient to cause rapid acceleration of a flame in either direction in the piping from a point of ignition, and eventual supersonic propagation.

The Detailed Report

(The following detailed report released by Standard of Indiana includes some of the same information which appeared in PETROLEUM PROCESSING in October, 1955. The complete report is presented here, however, in order to give you the full story in one spot.—Ed.)

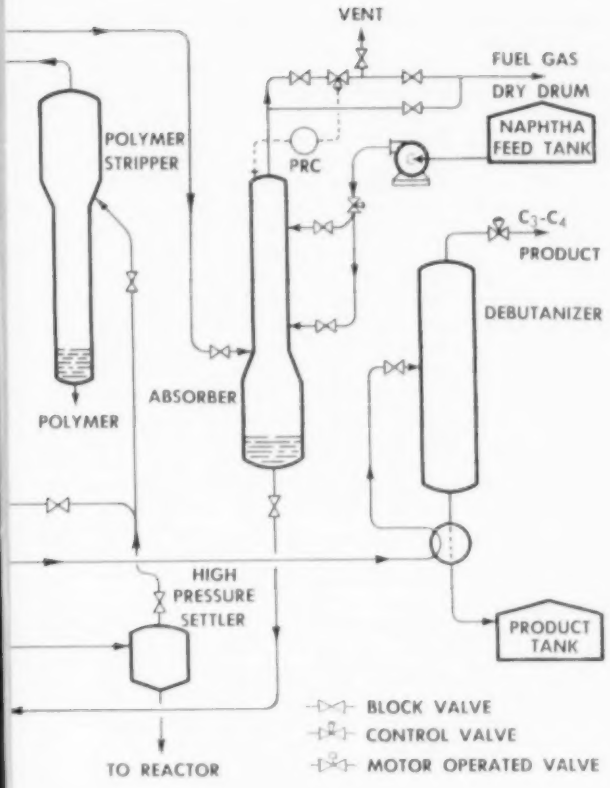
Summary of Accident

At approximately 6:15 a.m., Saturday, August 27, 1955 the Orthoflow Fluid Hydroformer at the Whiting refinery of Standard Oil Co. (Indiana) was seriously damaged by a series of internal explosions. The principal explosions occurred within the reactor vessel and a high pressure separator, completely destroying these. Other explosions occurred in piping exchangers, a separator drum, and the absorber tower, but the damage in these was less serious and save for two pipe elbows none was ruptured.

The violence of the explosions in the reactor and separator drum was sufficient to produce a substantial number of fragments. The fragments, and particularly those from the reactor, were scattered over an area of about 1200 ft. radius. Many of these fragments fell in two working tank fields immediately to the north of the Hydroformer.

The impact of the fragments on the tanks resulted in numerous fires which spread rapidly through substantially all the other tanks in these fields and resulted in the total destruction of 63 tanks and approximately 1,270,000 bbls. of crude and various products. Forty-six other tanks were damaged by fire or fragments.

The violence of the explosion in the reactor is attested to by the fact that a piece of plate weighing approximately 65 tons was thrown a distance of about 1200 ft., practically demolishing a 90 x 40 ft. tank containing 14,724 bbls. of naphtha.



What This Chart Tells You

This schematic flow diagram shows the Indiana Standard Fluid Hydroformer Unit as installed at Whiting. In addition to identifying the main equipment items and normal flow plan, it will help you follow the story by pointing up a number of key factors in the start-up operation and subsequent explosion:

The solid red lines trace the Recycle Gas System. Circulation of inert gas was started through this system at 2:00 a.m. on Friday, Aug. 26.

The dashed red line shows the regenerator air system. Flow of unheated air was started shortly after 8:00 a.m. on Friday, Aug. 26; air heater was fired during 4 p.m. to Midnight shift that same day.

A First trouble was reported here — in the inert gas generator — at 2:20 a.m. Saturday, Aug. 27. Oxygen recorder had risen to 2%, fire in generator was out.

B Major explosions occured at these two points at 6:15 a.m. Saturday, Aug. 27 — in the reactor and in the high pressure separator.

C Possible source of air for explosive mixture was leakage from regenerator through one or both plug valves.

D Two possible sources of ignition are known — spontaneous ignition in recycle furnace, and spark ignition from static electricity in high pressure separator.

Note: Times given are approximate.

Description of Unit

The Hydroformer was of the Orthoflow design, in which the regenerator was located above the reactor in vertical alignment and separated from it by an intermediate common head. The regenerated and spent catalyst circulating pipes were located within the reactor and were connected to the regenerator through attachment to the intermediate head.

The process flow for the unit is shown in simplified form in the diagram above. In normal operation, preheated naphtha feed and recycle gas, largely hydrogen, are mixed in the fluidized catalyst bed in the reactor under conditions (design) approximating 940° F. and 225 psig. Spent catalyst in the reactor is lifted through the spent catalyst standpipe to the regenerator where coke is burned off the catalyst with air at about 100° F. Regenerated catalyst is returned through the regenerated catalyst flow pipe to the reactor. Appropriate plug valves are provided at the bottoms of these two circulating pipes to control the rates of flow.

Product vapors from the reactor are cooled in overhead exchangers and partially condensed by the recycled liquid in a quench drum. The condensate from the quench drum, containing some catalyst, flows to a high pressure settler where an oil-catalyst slurry stream is separated from the decanted oil and returned to the reactor.

The decanted oil flows into a stripper where the heavy ends are removed. The balance of the oil from the stripper is mixed with the overhead vapors from the quench drum and this stream is then cooled and passed to the high pressure separator.

Bottoms from the separator are fractionated to give a debutanized product. Part of the gas from the separator is returned via the combination furnace (recycle gas and naphtha) to the reactor. The remainder of the gas is fed to an absorber where light ends are removed by the fresh feed and the stripped gas is then passed into the fuel system.

Pressure control of the reactor-generator system depends on two automatic instruments. One holds a constant back pressure on the reactor by throttling the flow into the absorber overhead gas line. The second maintains a constant differential pressure between the reactor and the regenerator by controlling the flow of flue gas from the regenerator. This differential pressure is sufficient to prevent back flow of air from the regenerator into the reactor but at the same time is low enough to permit circulation of catalyst between the vessels.

An inert gas generator is provided in the unit to produce inert gas for testing and purging purposes during start-up operations and for aeration of catalyst lines and bleeds to keep catalyst out of nozzles, stuffing boxes, moving parts and the like. The system consists of: a low pressure generator firing natural gas and producing 50,000 SCFH of inert gas, high pressure gas compressor (350 psig), 2000 cf (volume) high pressure storage drum, chemical dryer, and necessary coolers, dry drums and instrumentation. Automatic controls with alarms are installed to stop the flow of air and gas to the generator in event of flame or cooling water failure.

Start-up Procedure Used

At the time of the explosions, the operating personnel were in the process of starting up the unit following a shutdown for maintenance and alterations.

Pressure Tests and Purge

An air test of 225 psig was applied to the reactor and regenerator. This

test was started on the 4:00 p.m.-12 midnight shift on Wednesday, August 24, 1955. The air was supplied by the air blower, normally used to supply combustion air to the regenerator, through the combustion air line to the regenerator. The plug valves in the bottom of the reactor, normally used to control the catalyst to and from the reactor, were opened to permit air to pass into the reactor from the regenerator. The reactor and regenerator were isolated from the "oil" side of the unit for this test. The air test was completed during the same shift (4-12) on Thursday, August 26.

Concurrently, the "oil" side of the unit, consisting of all elements which in normal operation contained hydrocarbons and/or hydrogen, had been purged and then pressure tested at 175 psig pressure with inert gas furnished by the inert gas generator system. Following these operations, the air was exhausted from the reactor-regenerator system through the regenerator vent valve to the regenerator stack. The balance of the air in the regenerator-reactor was then purged through the same vent system with inert gas obtained from the oil side of the unit by opening the block valve in the reactor overhead vapor line until the pressure on the oil side was down to 50 psig at which time the block valve was closed. On the completion of the purge, the reactor-regenerator pressure dropped to atmospheric pressure.

Establishment of Inert Gas Circulation

With the completion of the pressure tests and purging of the reactor and regenerator, the next step was to establish inert gas circulation through the use of the recycle gas compressor, which in normal operation was used to return recycle gas from the high pressure separator to the reactor system.

In the gas circulation, the compressor took suction on the dry drum and discharged gas through the shell side of the reactor vapor overhead exchanger to the recycle gas coils in the combination furnace, then through the reactor and the reactor overhead vapor line to the tube side of the reactor vapor exchanger, down to the quench drum and overhead from this drum to the quench drum overhead condensers, then to the high pressure gas separator and back to the compressor dry drum. The circuit is shown in the recycle gas system drawing. To isolate the regenerator from this circuit, it was necessary to close the catalyst circulating line plug valves in the bottom of the reactor.

This inert gas circulating step was established about 2:00 a.m. on Friday, August 26, 1955. In this circulation, fresh inert gas from the inert gas generating system was continuously supplied as make-up. The excess inert gas in the recirculation system was vented from the high pressure separator via the absorber tower to a vent valve which in turn discharge to a vent stack.

Establishing circulation permitted lighting of the first burners in the recycle gas radiant sections at about 3:00 a.m., August 26.

Establishment of Naphtha Circulation

After inert gas circulation had been established naphtha was brought in to the unit via the absorber tower at about 5:30 a.m. on Friday, August 26. A normal start-up flow of about 10,000 b/d of naphtha was then established from the absorber tower through the naphtha coils located in the combination furnace to a start-up reactor bypass line which joined the line carrying the inert gas stream just ahead of the high pressure quench drum.

Circulation of the naphtha through the naphtha convective section tubes in the furnace was made necessary by the fact that this convective section is common to both the naphtha and recycle gas radiant sections in the furnace and this required that the convective section be cooled when the recycle gas section of the furnace was fired.

As soon as an oil level was established in the F-5 high pressure quench drum, circulation of a stream of oil from the bottom of the quench drum to the top of the drum was started. A portion of the oil in the bottom of the quench drum, together with that collected in the high pressure separator, was then pumped to the debutanizer tower and from there back to tankage.

The balance of the quench drum oil was pumped through its normal operating channel to the polymer stripper tower and then sent to the absorber sponge oil inlet. Oil circulation was thus established in all parts of the oil side except the reflux systems of the debutanizer tower and the polymer stripper.

It should be noted that after the establishment of recycle inert gas circulation and the naphtha circulation, contact between this recycle gas and the naphtha was made in the high pressure quench drum.

When the recycle gas was later separated in the high pressure separator, it contained approximately 2-3% hydrocarbons, principally pentanes and hexanes. This amount was sufficient to satisfy the combustible requirement for an explosive mixture. Hence, thereafter the recycle gas could not be considered inert although it still would require sufficient oxygen (estimated at about 10% minimum) to make it explosive.

This level of hydrocarbons was thus maintained on that portion of the gas recycling system consisting of the high pressure separator, the compressor suction drum, both sides of the reactor overhead exchanger system, the recycle gas furnace coils, the reactor, the connecting piping. The hydrocarbon level in the quench drum was considerably higher (after heating as noted below) because of the higher temperature maintained in the drum.

Heating Up Operations

After circulation had been established through the recycle gas furnace coils, four burners in the two recycle gas radiant sections were lighted at about 3:00 a.m. on Friday, August 26, 1955 for the purpose of heating up the recycle gas so that it could be used for the drying out of a new concrete bottom that had been placed in the reactor. A temperature of about 200°F was reached and maintained in the reactor for a period of about eight hours.

On the 4-12 shift of Thursday, August 26, 1955, additional burners were lighted in the recycle gas radiant sections to increase the temperature in the reactor. The rate of heating in the reactor was specified to be 50° per hour until a reactor overhead temperature of 600°F was reached.

Actually, after a temperature of about 335°F had been reached in the reactor with a maximum recycle gas temperature of about 515°F, further effort to increase the temperature was postponed because of difficulties experienced with the inert gas generator.

As mentioned before, naphtha was circulated through the convective section in the combination furnace to protect the convective tubes from overheating shortly after the recycle gas radiant sections were fired. This heated the naphtha leaving the furnace and entering the high pressure quench drum to a temperature of about 150°F.

Although this naphtha was in contact with the recycle gas from the reactor, the temperature in the quench drum is not significant in terms of

the hydrocarbon content of the recycle gas in the balance of the system since at the point of separation of the gas from the naphtha (high pressure separator) the temperature was approximately atmospheric (estimated to be 80-100°F).

As the heating of the reactor progressed, a periodic check was made on the compensating springs of the catalyst circulating plug valves in the bottom of the reactor. These springs are necessary in order to provide for the differential expansion occurring between the spent and regenerated catalyst pipes and the reactor shell during the heating up process.

It should be explained here that the reactor is heavily insulated on the inside to reduce the operating temperature of the reactor walls and bottom head. With this arrangement, the catalyst circulating pipes in the reactor will heat up more rapidly than the vessel wall and thus expand in a downward direction against the plugs of the valves. The plug of each valve is supported on a stem which enters the bottom of the reactor through a sleeve. The seats for the valves are incorporated in the lower ends of the catalyst pipes.

The initial differential expansion of the pipes thus will place a compressive load on the valve stems of such magnitude that compensation must be provided to limit the compressive forces. This is done by means of the compensating springs acting on the valve stems. However, even with these springs it is necesary to occasionally back off the plugs to limit the compression in the springs. Later, the shell of the reactor will heat up faster than the internals and tend to separate the plugs from their seats. The springs will then serve to maintain seating pressure.

Automatic follow-up is provided to maintain proper spring compression if the differential expansion of the shell is beyond the expansion limit of the springs.

According to operating records, periodic checks were made to determine that the springs were functioning properly. Operating records also indicate that a final check was made about 6:00 a.m. on Saturday, August 27, 1955 and the springs of both valves were reported to be correctly compressed, indicating as far as external inspection would permit that the valves were closed.

Regenerator Heating

The combustion air compressor which had been used to supply air for testing the regenerator-reactor was left in operation after the air test was completed by opening a vent valve and closing the valve in the discharge line from the compressor to the regenerator.

During the 12-8 shift on Friday, August 26, 1955, after the plug valves in the catlyst circulating lines at the bottom of the reactor had been closed, the compressor was lined up to send air to the regenerator via an air heater so that the regenerator could also be heated at approximately the same rate as the reactor. The air compressor discharge was raised to about 150 psig and the flow to the regenerator was set at about 450,000 SCFH. Actual admission of air to the regenerator started shortly after 8:00

Time Table of Start-up Operations Prior to Explosions

This table of events leading up to the explosions which destroyed the Whiting Fluid Hydroformer is based on data contained in the company's report. It has been compiled by the editors of PETROLEUM PROCESSING *to assist the reader in following the detailed description of the start-up operations.*

At about this time (or during this shift)	This activity took place
Wed., Aug. 24	
4:00 p.m. - 12:00 M	Pressure tests started on reactor and regenerator (using air, 225 psig), and on "oil" side of unit (using inert gas, 175 psig).
Thurs., Aug. 25	
4:00 p.m. - 12:00 M	Air test on reactor-generator completed. Vessels purged with inert gas from "oil" side.
Fri., Aug. 26	
2:00 a.m.	Inert gas circulation started, with fresh inert gas from inert gas generator supplied continuously as makeup.
3:00 a.m.	Four burners lighted in recycle gas radiant section of combination furnace, to heat recycle gas for drying new concrete bottom in reactor.
5:30 a.m.	Naphtha feed stock fed to unit, and oil circulation started (about 10,000 b/d).
12:00 M - 8:00 a.m.	Combustion air compressor lined up to send air to regenerator via an air heater.
8:00 a.m.	Actual admission of air (unheated) to regenerator begun (450,000 SCFH).
4:00 p.m. - 12:00 M	Additional burners lighted in recycle gas radiant section of combination furnace.
4:00 p.m. - 12:00 M	Air heater fired to preheat air to regenerator; regenerator temperature raised to about 250° F.
Sat., Aug. 27	
2:30 a.m.	Trouble first reported in inert gas generator: oxygen recorder reading had risen to 2%, and fire in generator was out.
5:00 a.m.	Decision made to steam out burner in inert gas generator, after repeated attempts to relight it had failed.
6:00 a.m.	Catalyst circulation plug valve springs checked and found to be correctly compressed, indicating that valves were closed.
6:15 a.m.	Explosion occurred.

A.M. Friday, August 26, 1955.

A regenerator stack vent valve was available for the purpose of maintaining a suitable differential between the reactor and the regenerator. This vent valve could be operated by either of two controllers, namely, a pressure controller on the regenerator which would serve to maintain a constant pressure in the regenerator at any desired level or a differential pressure control which would serve to maintain any desired differential pressure (within certain limits) between the regenerator and the reactor.

A pneumatic instrument switchboard near the regenerator determines which of the two controllers is connected to the regenerator vent valve. Additionally, each of the two controllers may be set at the instrument board in the control room for either automatic or manual operation. With either controller, manual operation simply acts to position the valve stem of the vent valve and thus serves to maintain a fixed valve opening except insofar as the operator changes this by occasional manual adjustments. The operating records show that the air heater was fired on the 4-12 shift on Friday, August 26, 1955 and that during this shift the temperature of the regenerator had been raised to about 250°F.

Status Shortly Prior to Explosion

During the 12-8 shift on Saturday, August 27, 1955 trouble was experienced with the inert gas generator. This trouble was first reported about 2:30 a.m. when it was noticed that the reading of the oxygen recorder had risen to more than 2%, and the fire in the generator was out. The generator was shut down, blocked off and vented to the atmosphere and thus isolated from the recycle gas system. As previously indicated, additional heating of the reactor and regenerator was discontinued and the temperatures in these two vessels were held constant pending the re-establishment of proper combustion in the inert gas generator. In order to conserve inert gas from limited storage, the vent valve on the absorber outlet was pinched down but apparently not completely closed.

Repeated attempts were made to light the inert gas generator but all failed and about 5:00 a.m. on Saturday, August 27, 1955, it was decided to steam out the burner. This was done and arrangements were then made to again light the burner. During the process of doing this it was discovered that the inert gas generator chamber was approximately half full of water which probably accounted for the difficulties experienced with the burner. Immediately following the discovery of water in the chamber the explosions occurred.

At 6:00 a.m., as mentioned, a check showed that the catalyst plug valve pressure compensating springs functioned properly.

It should be observed that neither the reactor nor the regenerator had been charged with catalyst and accordingly no hydrogen had been generated in the operation. The hydrogen analyzer in the recycle gas circuit confirms that no hydrogen was present.

The explosions occurred about 6:15 a.m. Saturday Aug. 27.

Description of the Fire

As previously indicated the explosions in the Hydroformer scattered numerous fragments over a wide area. Many fragments, including four large ones, fell in a residential area southwest of the Hydroformer, demolishing several houses and damaging others.

A number of tanks in two tank fields to the north of the unit were struck and pierced, or ruptured, by fragments and immediately caught fire. A 90 ft. x 40 ft. tank containing 14,724 bbls. of gasoline base stock and located near the north edge of the southerly, and larger field, was also struck and nearly demolished by a 65-ton piece of reactor plate.

This failure resulted in the immediate ignition of a pump house and a gasoline treating plant located across the road from the tank and adjacent to the north tank field. These fires spread to numerous other tanks in the two fields and a major conflagration soon developed with fire on the ground as well as in the tanks. Fire hose streams were played around the outside of the burning fields.

The combination of ruptured tanks, broken lines, tank boil-overs and water used to fight the fire caused the firewalls to overflow, with the result that the fire spread into a railroad classification yard which bordered the south tank field on the south and west. Burning oil flowed over a series of 13 tracks at about noon on Saturday August 27 and continued across Indianapolis Blvd., which is U.S. Highways 12 and 20.

At the same time the fire travelled north along the railroad tracks and highway and ignited the south end of a six-track loading rack. The fire in the classification yard and loading rack area destroyed a total of 73 cars and damaged 8 others. Sixty-six additonal tank cars had been pulled out from the loading racks before the fire reached that point.

About 10:00 a.m., Saturday, Aug. 27, the intense heat from the fire in the north tank field ignited another pumphouse and set fire to a gas holder on the west side of this field. The gas holder was extinguished with liquid foam with minor damage resulting.

At about 4:00 p.m., Saturday, August 27, the fire spread from the south tank field to the east into a receiver yard and ignited 10 small receivers used in connection with two crude running batteries. Between 4:00 p.m., Saturday and 4:00 p.m. Sunday Aug. 28., the fire was contained and no additional spreading occurred.

However, at 4:00 p.m. Sunday, a residual fuel tank which had been pierced by the initial explosion and had been on fire for about 24 hrs. boiled over. This tank was located in the southeast corner of the south tank field. The boil-over set fire to a third pumphouse, five additional receivers associated with a crude running battery and burned out the wash and locker room of that battery. No further spreading of the fire occurred, although many tanks continued to burn for several days.

All tanks in the north tank field were extinguished by Wednesday, August 31, and the last tank to be put out, a crude tank in the south tank field, was extinguished at 11:00 a.m., Sunday, September 4, eight days after the initial explosion.

Sixty-three tanks and receivers with a total capacity of about 1,950,000 bbls. were destroyed, 12 tanks with a capacity of about 250,000 bbls. suffered major damages, and 34 tanks with a capacity of about 10,000 bbls. received minor damages. The tanks ranged in capacity from 155 bbls. to 90,000 bbls. Stock destroyed in the tanks amount to 1,254,160 bbls. consisting of crude, residual fuels, reduced crude, distillate fuels, gas oil, finished gasoline and gasoline base stocks.

The fire on the Fluid Hydroformer itself was small and burned itself out in less than two hours after the explosion.

Early in the fire, all plant telephones, all Bell System telephones and all dispatch points to the main radio transmitter were put out of commission. It was necessary to use radio equipped cars and trucks for communication purposes. The refinery had about 36 of these and some were set up at key locations throughout the plant to maintain communications.

For Your Own Files

Another New Data Series

ENGINEERING and design data is not particularly hard to obtain. Most engineers and petroleum processing men have probably developed their own individual files of data.

To help you round out your files and continue developing your own "do-it-yourself" data file, the Editors of PETROLEUM PROCESSING are starting in this issue a new series of easy-to-use, simple-to-file engineering data sheets. Turn to page 101 for the first.

Like the new Process Data Sheets which began in the November, 1955, issue, these new Engineering Data Sheets have been prepared for your convenience. They are perforated—so you can remove them quickly and neatly. Punch holes have been indicated in case you like to file such information in a loose-leaf binder.

The aim of this new series is implied in the name itself—engineering data. Information that can help you solve every conceivable type of design or engineering problem will be at your fingertips as you build up your file from each month's "Clip-n-File" data sheet.

For example: the first few installments will deal with fundamentals—this month's subject is pressure: following topics will include temperature, flow, materials of construction, and the like.

These broad basic topics will then be broken down into areas wherein the fundamentals apply. For example: further data sheets involving pressure fundamentals will soon come your way on such kindred subjects as these:

- Pressure drop in pipe and fittings
- How to size piping
- Fluid flow relationships
- Pressure nomographs

A series in the field of temperature will include such items as:

- Heat transfer
- Insulation factors
- Fuel economics

Here's what you will find in the first of your new "Clip-n-File" Engineering Data Sheets, pg. 101 in this issue, on Pressure fundamentals:

- A definition of pressure
- What causes pressure
- Its relation to other variables
- How it is measured
- Units of measurement
- Pressure equivalents.

THIS IS GOOD PRACTICE—use lift trucks and pallets, storing lubricant drums upright and under a protecting roof

IF DRUMS MUST BE OUTDOORS UNPROTECTED, rack them on their sides and mark them so you get the right lubricant

Handle Your Lubes with Care

The pay-off will be in having them in shape to do a good job any time you need it done

Like the roofing manufacturer whose roofs always leak in a rainstorm, there are probably many petroleum refineries where lubrication practices could be improved with a better knowledge of handling and storage of lubricants.

Whether you manufacture lubricants or merely use them, you can profit by the tips in this article for keeping your lubricants in top-flight conditions so they can perform the way they were designed to perform.

By ROBERT K. GOULD
The Texas Co.

SATISFACTORY lubrication depends upon a combination of several factors. One of the most important —and frequently overlooked—is that of keeping the lubricant in the same condition from the time it was packaged to the time it is applied. It matters little how much care might be devoted to the selection of the lubricant or how efficient or elaborate the equipment may be for applying it, if at the moment of application it is not in a suitable condition.

The least that could happen from careless and improper storage and handling would be loss of the lubricant, provided the condition was noticed in time and the material discarded.

However, if contamination or any other abnormal condition was not detected before the lubricant was used, the outcome could be very serious and costly. This would be particularly true if it caused a lubrication failure on some expensive machinery.

Leakage Means Waste As Well as Hazards

Loss of lubricant from damaged containers, loose fitting plugs, or careless handling (spills) represents material that has been bought but not used. A buyer would certainly not expect to receive only partly filled drums from his supplier. Furthermore, he would never deliberately pour a portion of lubricant down the drain. Yet, the final results would be the same in any case. And it all adds up to waste.

Also serious are the safety hazards created by spilled lubricant. The oil is designed to reduce friction when there is motion between two parts in contact, but not when one of these parts is the sole of a shoe and the other is the floor. Many bruises and broken bones have been caused by falls on oil-slick floors. Oil on the floor is particularly hazardous when its color blends with the color of the floor so that the spot is almost unnoticeable. Spilled oil also creates a fire hazard, particularly in certain areas.

Contamination Brings Problems Too

All contamination is undesirable. However, the extent of the damage that results will vary, depending upon

PREVENT CONTAMINATION and void leaks by using a suitable transfer pump

the type of lubricant and the nature of the contaminant.

In general, lubricants that contain additives will be affected more adversely than will straight mineral oils. For example, a little moisture will not result in permanent damage to straight mineral oils. They may become cloudy but will clear up after standing, as the moisture settles to the bottom.

Certain additives, on the other hand, may be water sensitive. They may be removed partially or even completely by contact with only trace amounts of water. Water will also cause separation or lump formation in certain types of greases.

Dirt, dust, or other solid body contamination can be especially harmful if not discovered in time. These materials not only accelerate oil oxidation and result in shorter oil life, but also can cause serious damage to moving parts of machinery because of their abrasive properties.

Thus, contamination of the lubricant is certainly to be avoided. At best, it can cause extra handling if discovered before the lubricant is used —filtering out solid particles or allowing water to settle out. However, it may destroy permanently some of the important properties of certain additive type lubes—properties essential for satisfactory performance. And finally, if the contamination is not detected, some very serious machine damage, costly repairs, and extensive downtime can result.

Extreme Temperatures Are Harmful

Exposure of lubricants to either abnormally high or low temperatures can result in temporary or permanent damage, depending upon the nature and composition of the product. Again, it is the additive types which are most subject to harm.

Of the two extremes, contact with 'ow temperature is by far the more prevalent. This is owing to outdoor storage in areas where winter weather becomes very cold.

Soluble oils are one type of product that can be affected adversely by subfreezing temperatures. These materials normally contain numerous components, including a small amount of water, all of which are present in a very delicate balance. Prolonged exposure at low temperatures may cause stratification and separation of the ingredients and destroy the properties of the product.

Fortunately, most soluble oils which have been so affected can be reconstituted by agitation to remix the ingredients. The reconstituted product may not be as good as the original in all respects, but in most cases it will be usable.

However, if separation has occurred and is not discovered before the product is used, the soluble oil will be worthless because it will not mix with water to form a satisfactory emulsion.

Lubricants containing fatty materials are examples of other products that may separate on exposure to low temperatures.

Even if nothing else happens, lubricants and greases stored in cold areas become viscous and stiff, and in such condition that they are very difficult to handle. Various means can be and are used to raise the temperature of cold, stiff lubricants. It is wise, however, to avoid direct heat application. This always brings the danger of developing local overheating which may ruin the lubricant.

For example, referring to the soluble oil again, the loss of just a small

SUITABLE OUTDOOR STORAGE for lubricant containers requires overhead cover but no side walls

amount of the water of composition by evaporation may cause the oil to jell and render it worthless. Exposure of greases to high temperatures may result in separation of the oil and soap.

Don't Mix Types and Brands

To a good many people, including those concerned with machine operation, oil is oil and one is just the same as another. Properties of lubricants and requirements of the equipment mean little or nothing. Some operators tend to use whatever material is nearest at hand, especially if it "looks right."

Obviously, the chance of this happening is slight where the handling, dispensing, and application of lubricants is controlled, supervised, and administered by qualified personnel. However, this is not always the case. Indiscriminant mixing of types and brands can have serious consequences.

A Check List For Proper Procedure

Every plant, regardless of the size of lubrication requirements, has a problem by the mere fact that lubricants must be stored and handled. Because no two plants are exactly alike and because numerous local factors must be considered, the problem is more or less specific for each individual plant.

However, here are some basic rules and some "do's" and "don'ts" which apply to all storage and handling operations.

Unloading

1—For the easiest and simplest handling of drums, there should always be an unloading platform level with the truck or freight car.

2—If there is no unloading platform, use a ramp and slide the drums endwise to the ground level. Or use a lift truck.

3—Do not drop drums from the truck or freight car to a cushion, such as a rubber tire. Drum seals can be split and leaks will occur.

4—Rolling the drums if satisfactory for transfer from unloading to the storage area if the distance is short.

5—For longer transfer distances, hand trucks, lift trucks, or metal tracks will place less strain on the seams.

Storage

1—Choose the storage area carefully. Select a central location so that hauling distances are as short as possible. Also, select an area where the atmosphere is free of dust and vapors.

2—Store indoors if possible. Chances of contamination will be less.

3—If storage is to be outdoors, the drums should be placed on their sides and on racks. Don't lay them on the ground. If they are upright on end, rain water may accumulate and be sucked into the drum by normal breathing action. If stored outdoors on end, even temporarily, drums should be covered for protection.

4—An indoor storage area, whether a separate building or a shared space, should be fireproof, have brick, tile, or concrete walls and floors, and be fitted with suitable drains. Wood construction, besides being non-fireproof, is more difficult to keep clean.

5—Cleanliness is essential regardless of whether it's indoor or outdoor storage. For indoor storage, the area should be painted in light colors, preferably white. Regular cleaning schedules should be maintained.

6—Orderliness is another must. There is less chance for confusion and error when different types and brands are kept separate and in their proper places.

7—Don't store more than is necessary. The lubricant supplier will be glad to make a survey of plant lubrication requirements with a view to keeping the number of different types to a minimum. This also will reduce chances for confusion.

8—Exercise extreme care in heating lubricants that have been exposed to low temperatures. If possible, transfer the drums to a warm area and allow them to reach room temperature. If more rapid heating is required, use exhaust steam. Never apply direct heat, such as a flame, to the outside of a drum. This would melt the sealing compound and cause leaking. It might also harm the product.

9—Remember that exposure to temperature extremes can damage lubricants. If there is any reason to suspect that this condition has occurred, examine the lubricant before using it. If it appears abnormal, consult the supplier. It may have to be discarded or it might be salvaged.

Dispensing

1—Whether your plant is large or small, lubricants should be dispensed under the supervision of personnel who are thoroughly familiar with lubricants and lubricant requirements.

2—The actual mechanics by which the lubricant is transferred from storage container to the point of application, and the transfer equipment used, will depend upon the particular plant involved.

Transfer pumps are available which fit standard grease or lubricant drums and permit removal of material from its original container with no danger of contamination, waste, or mess. The lubricant can be transferred to smaller units such as power guns, hand guns, or small containers and thence to the point of application.

Schemes can be developed for applying the lubricant directly from the drum if desired, thus eliminating the intermediate transfer operation. For example, a drum equipped with a pump, hose, and control valve, can be mounted on a dolly and brought directly to the place the lubricant is needed. Or a system can be devised whereby the lubricant is piped from the drum to the area where it is required. Hoses can then be connected to the pipe outlets to carry the material to the machine.

Even for equipment which has centralized lubricating systems, arrangements can be made to transfer the lubricant directly from its original drum.

3—All equipment used in transferring lubricants should be located centrally and should be kept clean.

4—Where many different lubricants are used, a simple code system can help to avoid confusion. Such a code, whether alphabetic or color (and be careful of color blindness) should be clearly evident on the drum, the transfer equipment, and the point of application.

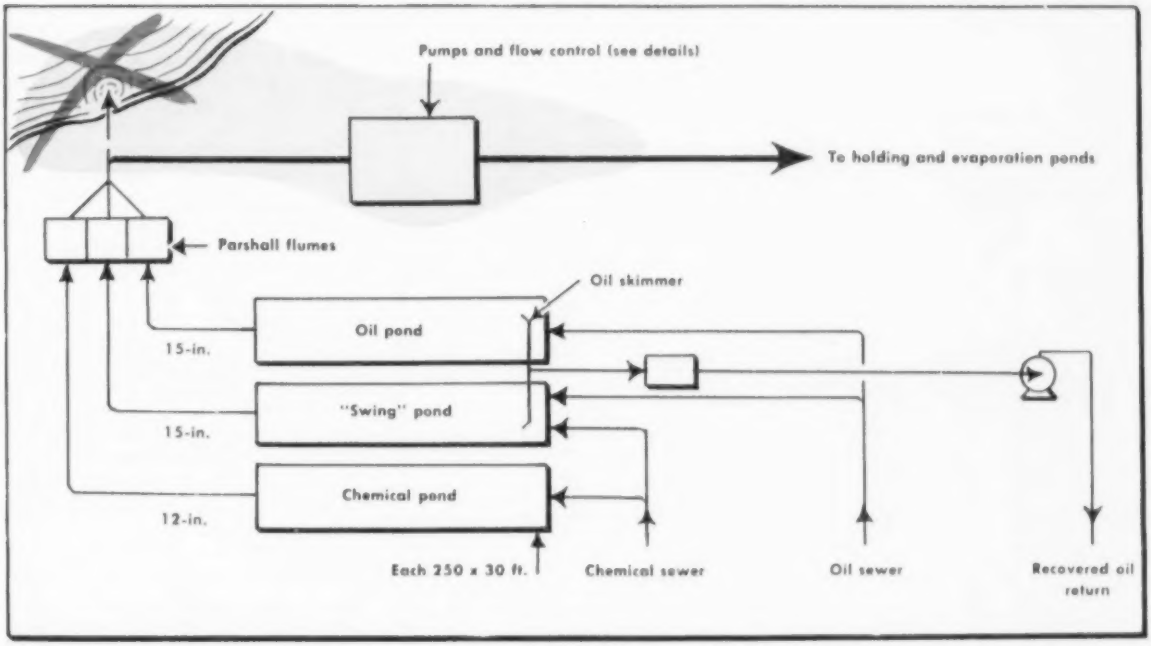
5—Keep accurate records of the lubricants used. Use old stocks first.

6—Keep the oil dispensing area clean. Don't let spilled or drip oils accumulate.

7—Keep fire protection equipment handy.

Meet the Author

Robert K. Gould is a chemist on the technical service staff of the Research and Technical Department, The Texas Co. He is also editor of Texaco's monthly publication, *Lubrication*. Dr. Gould took all his undergraduate and his graduate work at Duke University. He was awarded his A.B., M.A., and Ph.D. degrees by Duke, the last in 1941. Dr. Gould joined The Texas Co. as a research chemist that same year.



NO STREAM POLLUTION HERE—all wastes from Socony's Casper refinery now go to open ponds for evaporation

For Better Waste Disposal

To the Hills Instead of the River

By D. P. THORNTON, Jr.*

SOCONY Mobil Oil Co. has come up with something fairly unique in the disposal of liquid wastes from its Casper, Wyo., refinery, located on the North Platte River.

Effluent no longer enters the river. Instead, it is all sent to natural basins in a 750-acre area in the sand hills about three-quarters of a mile north of the refinery. Here, most of the water evaporates owing to the low humidity in this region; the remaining waste seeps into the soil. None of it reaches the river.

The story of how this was done represents not only ingenuity but also the desire of an oil company to be a good neighbor. It should be emphasized that no anti-pollution action was pending against the company nor was any contemplated so far as is known. Long before the river passes the refinery it is a polluted stream. Perhaps the worst offender is the city of Casper itself, which dumps untreated sewage down a simple outfall canal directly into the river.

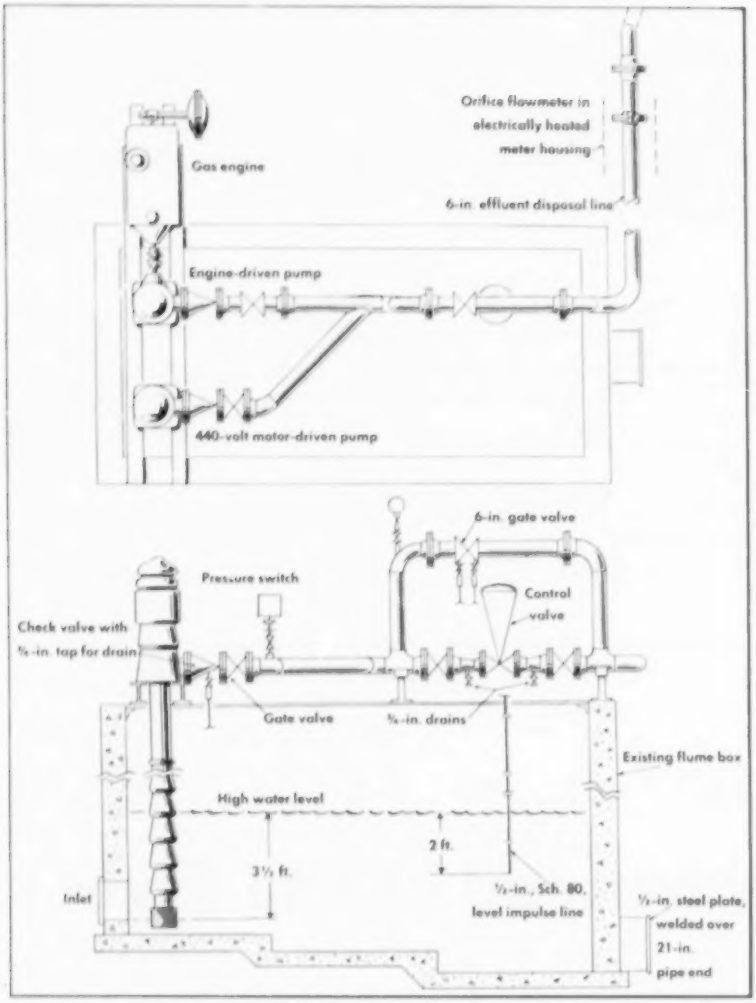
Plant waste all flows into a concrete sump, an existing flume box, measuring approximately 14 x 7 ft. x 8 ft. in depth. From this point, it is pumped at a maximum rate of 200 gpm through a 6-in. line across the North Platte to the natural basins. The waste water normally contains 5 to 10 ppm of phenols, but it has occasionally run as high as 50 to 75 ppm.

These natural basins are in an extremely sandy area, in sharp contrast to the gravelly soil characteristic of the south side of the river, where the plant is built and the city of Casper lies. Also, the rock lying under the sand slopes away from the river. Socony has built three dams to hold the waste water until it evaporates and to prevent any possibility of encroachment on adjacent property. The area is completely enclosed with a stock and sheep-tight fence.

Details of the effluent flow control system, flume box, pumps, etc., are shown in the accompanying drawings and photographs.

Careful control of the system is necessary for two important reasons. First: flow control is maintained to keep a check on refinery water use. If the quantity of effluent increases excessively without a corresponding increase in incoming water, investigation must be made. A tank drain may have been

*Mr. Thornton, southwestern editor, PETROLEUM PROCESSING, at the time this article was written, is now associated with Universal Oil Products Co., Des Plaines, Ill.



FLOW OF WASTES IS CONTROLLED by this installation in an old flume box

left open accidentally, or perhaps a cooling tower or a boiler blowdown valve has been opened too wide. These last two pieces of equipment are particularly expensive water users. Incoming water—taken from the North Platte—is very hard and requires extensive treatment.

Second: the effluent system must operate in extremely cold weather—at times as low as 40° below zero. For this reason, the normally operating pump is driven by a gas engine, whereas the spare is electrically driven (gas is less expensive than electricity in this area). A by-pass line keeps water running through the non-operating pump to prevent freeze-ups. A second by-pass line with a gate valve has also been provided around the flow control valve. This permits the system to operate when it is necessary to shut down the control system. Drains have also been provided on each side of valves and checks to prevent freeze-ups.

The control system holds the liquid level in the flume box to no greater variation than 2 ft. At the lowest point, it still provides a 1-ft. suction head above the foot-valves on the two pumps.

The stand-by electrically driven pump starts automatically in the event of failure of the gas-engine driven pump. A pressure switch on the pump discharge line is set to energize the electric motor when discharge line pressure falls to about 50 psi., indicative of malfunction of the gas-engine driven pump through a mechanical problem or a loss of fuel gas supply.

This is not a re-setting switch. The engine driven pump must be put back into service manually. However, the installation is on a regular operator's routine "beat"; thus the motor could run but a short time before being discovered.

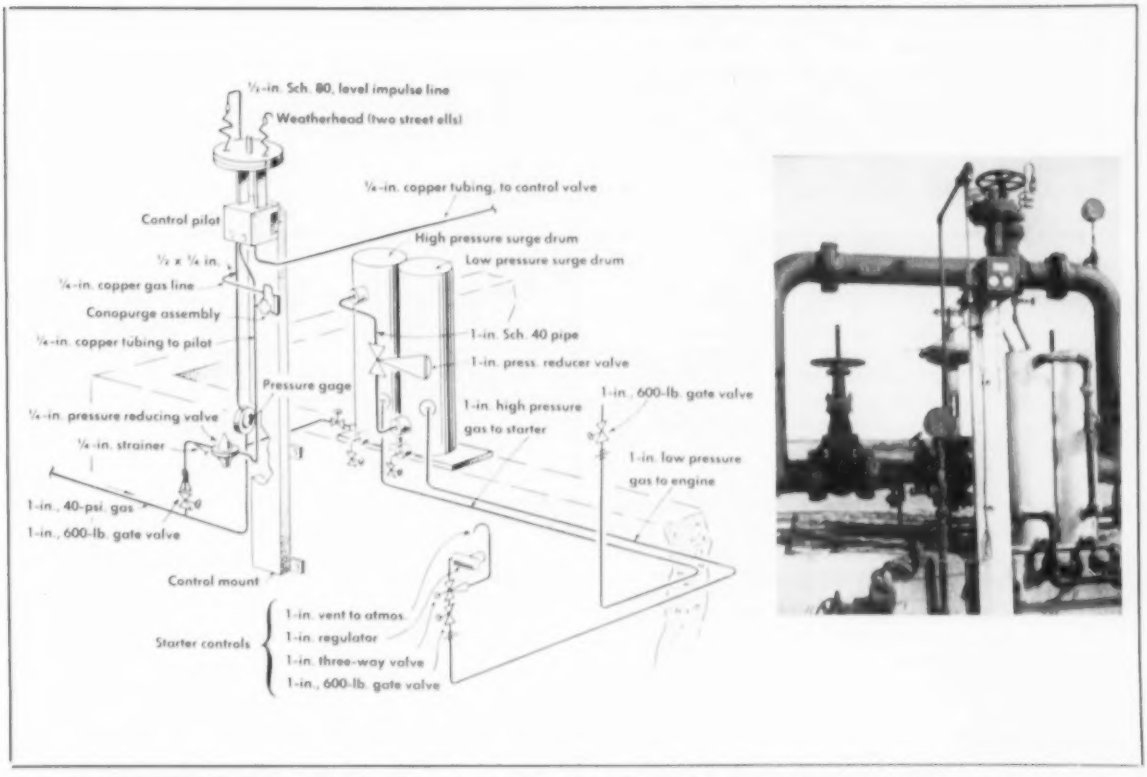
Since gas is used as an engine fuel, it is also used as a control medium to avoid piping instrument air this far from main refinery. Gas at 40 psig. is used to operate the diaphragm motor control valve in the waste effluent line on a signal from a control pilot. A tap is taken off the supply line to the control pilot to operate a liquid level impulse line into the sump in the conventional manner. The gas supply is piped into a high pressure surge drum to minimize any upsets due to variations in fuel gas pressure. From this high pressure drum, a low pressure surge drum also is supplied with gas. The pump engine draws its fuel from the latter drum. The mechanical starter for the gas engine also is supplied from the high pressure gas line and surge drum.

Feed liquid waste to this flume and flow control installation comes from three holding ponds. The refinery uses two completely separate sewer systems. One is for oil and the other for water and chemical wastes. The three holding ponds, or settling basins, are each 250 ft. long by 30 ft. wide. One is for the oil stream, one is for the chemical stream, and the third serves either stream while any single basin is being cleaned out.

Other practices at Casper are pretty much conventional, though some of the equipment has been "shop made" by converting existing but idle units. For example, the oily water streams are collected in an old separator whose design and construction antedates even the earliest API separator designs. The recovered oil is returned to slop tanks for re-running, and the water is pumped to an old agitator—surplus since Doctor-treating days. This agitator acts as a secondary separator with its oil layer also being sent to the slop tanks. Water from this agitator is mixed with the chemical waste stream.

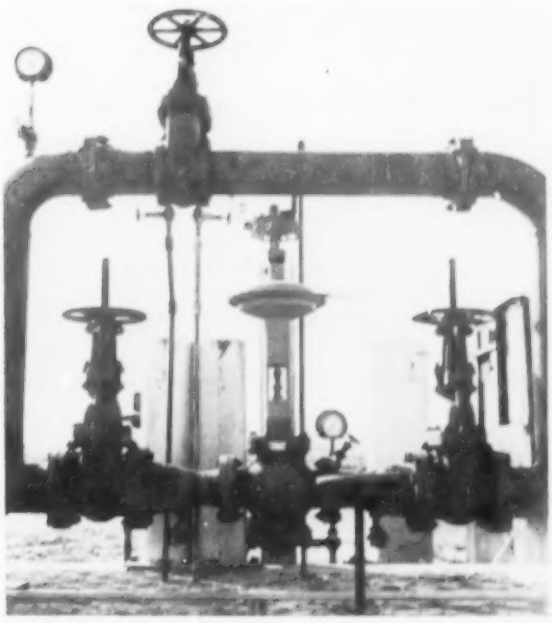
The entire system went into operation June 20, 1955. From that time until late September, not a drop of plant waste had gone into the North Platte River. Nor had there been any plant upsets because of the waste disposal system.

After some 90 days of continuous 200 gpm average flow into the sand hills, one pond had formed of perhaps 5 to 7 acres in extent. There had also been some heavy rains. It was believed the pond could probably grow to 400% its size at that time before it would overflow the first dam; and this was still the smallest basin of three on the property.



GAS SYSTEM DETAILS, including use of gas as engine fuel and as a control medium in place of air

COMPACT AND ALMOST AUTOMATIC, here is the effluent pumping system for liquid waste disposal at Casper



CLOSE-UP OF FLOW CONTROL. By-pass valve at top permits maintenance of diaphragm valve without a shutdown

TOPS in 'What's New!'—1955

Here are brief reviews of the most interesting items presented in the monthly "What's New!" section during the past year. As a service to readers who have missed them, or may not have been receiving the magazine, or may now find them of value in their work, the editors have assembled these "Tops in What's New!—1955" on this and the following page.

A code number has been assigned to each item. You are invited to use the regular Reply Cards, which you'll find following page 126, to request further information about equipment or copies of helpful trade literature.

Vapor Pressure Charts

. . . for use as standards for specification and control purposes: 20-page booklet, *Vapor Pressure Charts for Petroleum Hydrocarbons*, has been approved for distribution by the API Committee on Petroleum Products. The American Petroleum Institute, 50 W. 50th St., New York 20, N. Y.

Circle No. **1** *on Reply Card*

Teflon Technical Data

. . . covering the history, general characteristics, manufacturing operations, compositions, physical and chemical properties, molding recommendations, uses and other information in 60-page *"Teflon"* manual. E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.

Circle No. **2** *on Reply Card*

Ammonia Synthesis Process

. . . using natural gas or practically any refinery gas —saturated or unsaturated: *Bulletin No. 0-54-1* gives descriptions, flow diagrams, and process data for the six stages in the processing sequence. Foster Wheeler Corp., 165 Broadway, New York 6, N. Y.

Circle No. **3** *on Reply Card*

Oil-Water Separation

. . . for refinery waste water: *Technical Reprint T-124* discusses methods of treating waters containing oil, and the de-oiling of refinery waste water for reuse. Graver Water Conditioning Co., 216 W. 14th St., New York 11, N. Y.

Circle No. **4** *on Reply Card*

Organic Chemicals Properties

. . . on more than 350 synthetic organic chemicals: booklet *F-6136* gives gravities, vapor pressures, solubilities in water; and boiling, freezing and open cup flash points. Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.

Circle No. **5** *on Reply Card*

Steel Dictionary

. . . of terms valuable to those using cold finished steel bars: 32-page *Helpful Data Bulletin No. 6*, entitled "Simplified Steel Terms and Engineering Data," includes more than 180 detailed definitions frequently used in the purchase and manufacturing of steel. LaSalle Steel Co., Chicago 80, Ill.

Circle No. **6** *on Reply Card*

Automation

. . . and its technical terms most broadly used are defined in *Automation Dictionary:* some 87 common words and phrases used in discussion of automatic control are defined in simple terms. Brown Instruments Div., Minneapolis-Honeywell Regulator Co., Wayne and Windrim Sts., Philadelphia, Pa.

Circle No. **7** *on Reply Card*

Compressed Air Handbook

. . . aids in measuring effective air compressor capacity: *Bulletin No. 520-A* gives hook-up sketches and design tips for improving capacities of compressor installations. Includes a chart showing pipe size, air flow, gage pressure, and pressure drop. Sarco Co., Inc., Empire State Bldg., New York 1, N. Y.

Circle No. **8** *on Reply Card*

Corrosion Manual

. . . describes how to protect equipment through using special cements, bricks and plastic coatings: 23-page *Corrosion Engineers' Manual* gives construction basics, physical properties and corrosion resistance of protective materials; and tips on tank and floor construction. Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.

Circle No. **9** *on Reply Card*

Oil Industry Explanations

. . . for individuals, schools or other groups. The complex operations of the industry are explained in clear, simple language: 32-page *The Story of Petroleum* tells how exploration crews sink wells, how pipelines move crude to refineries, how chemists and engineers refine crude to oil, and how it is distributed. Shell Oil Co., 50 W. 50th St., New York 20, N. Y.

Circle No. **10** *on Reply Card*

Pipe Line Sampler

. . . operates automatically and is designed to extract accurate line samples of crude oil, fuel oil, gasoline and other liquids. The "Gilbarco Sampler" can extract as many as 300 small samples per minute to give representative composite samples. Control can be proportional to time or flow. Pressures to 350 psi and temperatures to 200°F are handled with standard models. Higher pressures, and up to 350°F, can be handled by special models. There is no motor or mechanical switch, but instead a small, low-capacity piston pump, magnetically operated from 20 to 300 cycles/minute. The entire assembly is explosion-proof. Stainless steel and other resistant materials are used. The sampler handles a wide range of viscosities, and is not affected by changes in liquid viscosity or gravity. Gilbert & Barker Mfg. Co., West Springfield, Mass.

Circle No. **11** *on Reply Card*

Centrifugal Action Liquid Mixer

. . . operates on the principle of a centrifugal pump, and draws heavy liquids and lighter liquids alike through it. The "Rheinhuette" (German) mixer operates with a special impeller that rotates so rapidly that liquid is sucked from both top and bottom of it, and driven out radially at different velocities. The special design of the oval impeller, with circular opening at top and bottom connected by curved channels to side slots, drives liquid radially through the slots. The suction created by the outward slung liquid draws both heavy and light liquids in for replacement. The mixer is recommended for liquid-gas, liquid-solid, miscible and immiscible liquids, and other difficult mixing jobs. U. S. representative for the German mixer is Neumann & Weaver, Inc., 22-12 Raphael St., Fair Lawn, N. J.

Circle No. **12** *on Reply Card*

Recording and Controlling Viscometer

. . . provides a continuous record for petroleum applications. Through a temperature-compensated measuring element a small side-stream sample flows for viscosity determination. When necessary a heat exchanger can be used to bring the sample within the compensating temperature range; a small proportioning pump returns the sample to the main stream. A remotely located recorder furnishes a 24-hour record on a circular chart; and for automatic control the recorder provides 3-15 psi air for use with standard pneumatic controllers. All of the electrical components comply with Underwriters' requirements for Class 1 Group D locations. High sensitivity, accuracy and ruggedness are features of this viscometer. Norcross Corp., Dept. No. N33, Newton 58, Mass.

Circle No. **13** *on Reply Card*

Plastic Blanket Cuts Evaporation

. . . from tanks storing volatile liquids. Made of polyvinyl chloride, the blanket consists of a continuous, flexible carpet covering the free liquid surface up to within one inch of the tank wall. A "Z"-shaped skirt around the edge of the carpet forms a vapor seal against the side of the tank. Openings, fitted with vertical sleeves, allow measuring and sampling and also allow a liquid level indicator float to pass through the surface. Small holes every square yard allow evacuation of condensed water. Plastic tubes attached below the blanket prevent its dropping lower than the tank filling openings when the tank is empty. Electrostatic charges, which are built up in the tank during filling, are eliminated by means of a wire netting on the blanket. W. K. Archer Co., 75th and Cleveland Ave., Kansas City, Mo.

Circle No. **14** *on Reply Card*

Graphic Slide Rule Fits in Pocket

. . . and consists of two mathematical charts. Developed by E. J. George, a Sun Oil Co. engineer, the charts have the accuracy of a 7½ in. slide rule, and may be used without a straight edge. Consisting of a log scale superimposed diagonally upon a log-log grid, the "Multiphase Mathematical Chart" has scales for multiplication, division, square root, cube root, and logarithm of a number. The second chart, the "Multiplication and Division Chart," is similar but without the log, square, and cube root curves. Both charts contain illustrative examples to aid in their use. Test runs have shown chart calculations to be fifty percent faster than those made with a slide rule, and twice as rapid as a calculating machine. The charts may be carried in the back of a notebook, or placed under glass on a desk for use . . . or mounted under plastic for protection. E. J. George, 428 E. Magnolia Ave., Aldan, Delaware County, Pa.

Circle No. **15** *on Reply Card*

Scale Model "Erector Set"

. . . permits layout of plants in model form directly from the flow sheet. Pictures taken of the model plant can supplement the normal construction plans, and reduce the effort normally required for conventional drawings. The "PDQ" kit includes plastic and wood models accurately scaled to size and is suited for use in the design of chemical and petro-chemical plants. It is claimed that model construction can be done directly by the engineer from the plot plan and flow sheet. The Parco Co., Inc., 82 Beaver St., New York 5, N. Y.

Circle No. **16** *on Reply Card*

For information about current new products, equipment, process, or literature please turn to the regular "What's New!" section in this issue, beginning on pg. 129.

ETHYL PROMOTES

creative thinking

...AND TELLS

● *What it is* ● *How to use it* ● *How it pays off*

By ROBERT L. DAVIDSON, Assistant Editor

WE can all think creatively, but how many of us plan our creative efforts? How many of us take action on our ideas?

"You can't just sit back and wait for inspiration to strike. You must exercise your creative muscles to keep them active," says Charles H. Clark of Ethyl Corp.

Ethyl—sold on the value of idea stimulation—sent Charley Clark to over 25 refining companies to explain practical "Creative Thinking." Clark's 42-minute "flannel-board" talk is accepted enthusiastically. Some companies request a second visit. Others plan to start creative thinking training and "brainstorming" sessions.

"Creative thinking," says Clark, "like the weather, is not new. Only now we are doing something about creative thinking."

Twenty years ago, most business men did not consider idea stimulation programs practical. Alex Osborn—of the advertising agency Batten, Barton, Durstine and Osborn—was a lone voice preaching the practical value of generating ideas. Since then, many companies have started creativity programs, the oldest being General Electric Co.'s, born in the 1930's.

Today, Osborn is considered an authority on applied creative thinking. His book[1]—written with the aid of Charley Clark—is now used as a text in colleges, industry, and the armed forces.

Creativity programs have been started during the past year by 13 companies, including Ethyl Corp., Shell Oil Co., Standard Oil Co. (Ind.), Monsanto Chemical Co., Dow Chemical Co., Union Carbide and Carbon Corp., and U.S. Rubber Co.

Why have a creativity program? Increasing technical competition means that companies must generate new ideas—not just wait for random chance inspiration.

How does a creativity program work? Encouragement, incentive, and training are "musts" for management seeking more employe ideas. The employe must not only be able to produce ideas, but must know that ideas are wanted and appreciated.

What creative thinking is and how it works is told in Charley Clark's flannel-board talk, summarized on the following pages.

IDEAS—*get them—keep them—use them*——→

How Do You Get Ideas?

THREE major hurdles precede creation.

1—Proper attitude.

2—Finding the problem.

3—Defining the problem.

You have little chance for ideas if you feel no need for them. Why do we need ideas? . . . to meet competition. What can you gain from ideas? . . . most agree on money, recognition, promotions, personal satisfaction, time and effort saving, and helping others.

Suppose you agree that it is worthwhile to have ideas—but ideas about what? What is the problem?

Occasionally you have a ready-made problem, but usually too seldom to keep those "creative muscles" in tone. How do you look for a worthy problem?

Be willing to start small. Most things start small and imperfectly, so don't try to start at the top.

Where do you find problems? Go hunting. Ask questions. Always ask yourself "How can I do this better, differently, cheaper?" Or reverse the question to "What is wrong with this?" Negative questions can make a pet peeve and gripe list which is a source of problems.

Now your problem must be defined to give freedom to your thinking, yet keep you in the ball park. For instance, the study of a leaking pump could range from a narrow definition of packing glands to a broad definition encompassing methods of fluid movement.

Your problem is now defined—what next? Make yourself a problem sheet. On it write your defined problem (as you see it), barriers in the way of solution, and ideas for solving the problem.

The written sheet is important, as creative thinking is actually "associative thinking" where the mind hops, skips, and jumps around in grasshopper fashion. Many pieces of data along with previous ideas thus freely associate to form new ideas.

The conscious mind holds only a limited number of variables at a time, but the written sheet allows you to handle a great many variables at a time. A glance at the sheet lets the conscious mind make free associations and modifications on the written ideas to help.

How Do You Keep Ideas Flowing?

THE best route to creative, or associative, thinking is to practice constantly. Get into the habit of seeing the "creativity" that is all around you in everyday objects. Try to get ideas about everything and anything around you. Ask, "How would I do It?" Don't turn off your mind the minute you leave your job. Practice and build up your confidence.

If you are lucky enough to find your problem early, your subconscious mind can help a great deal. Let it tackle your problem while you sleep or relax. But if you wait until the last minute, you cannot count on subconscious aid.

When you are ready to grind out ideas, find a quiet place—avoid interruptions. Take your problem sheet, and jot down all ideas immediately as you think of them—don't trust your memory.

Let your mind flow out freely as you "think it up." Never try to judge your ideas as you have them. If you start to think judicially too soon, you will have a mental see-saw effect and set up tension and friction in your mind. You will lose momentum and hinder free association of ideas.

However, do not confuse free association thinking during an idea-making session with random daydreaming. The latter can produce some ideas, but is without control. An idea-making session is designed with a specific goal in mind.

Set "idea quotas" for yourself. Tell yourself that you will not stop until you have 8 or 10 or more ideas. Don't give up if ideas are slow in coming. Keep going until you feel the swing of it—until you get your second wind.

Scan the ideas you have already listed. Look for variations or combinations of these ideas by free association. Often, seeing one item leads your mind in an entirely different direction by association with other items hidden in your mind.

Always carry an "idea-trap"—a notebook. You never know when an idea will strike. Flashes often come unexpectedly, and may never return. The notebook will "trap" them for further use.

What Do You Do When Blocked?

IN spite of all your efforts and techniques, once in a while the ideas just will not flow. What then?

First, be sure that you did not give up too soon. Did you get your second wind? If you try again and are still blocked, let the problem rest. Give your subconscious mind a chance to digest the problem.

You might do well to re-examine your problem. Maybe you defined it incorrectly at the start. Try finding a new focus for the problem. Maybe your definition is too broad and does not give an anchor spot from which to start. Maybe your definition is too narrow and your field of thought is too limited.

Take an ax to your problem. Cut it into little pieces. Charles Wilson gave an example of this when he became Secretary of Defense. He found 4 million items in the 21-ft. high defense supply catalogs. Other Secretaries of Defense had given up hope of reducing the supply budget, but Wilson succeeded by breaking the big problem into little ones. He found that 300 supply items accounted for 50% of the supply budget. So he had those 300 items studied, and came up with a big savings in the supply budget cost.

Try reversing your problem. Instead of asking "What will work?" ask "What won't work?"

Several techniques or gimmicks can be used when you are blocked. These techniques do not necessarily give you ideas, but serve to help start a train of free associations going again. They include:

1—**Idea solitaire cards.** Make a check list of questions about your problem with each question on a separate file card. Study them one at a time until ideas start.

2—**Idea bank.** Make a file of clippings and ideas you have saved because they seemed clever or original. Study this file for idea stimulation.

3—**Read.** Always read with the question in mind: "How can I use this?"

4—**Talk it over.** Discussions with other people often give ideas and start your ideas flowing again.

5—**Brainstorm.** Engage in a group idea-making session, as described later in this article.

What Do You Do with Ideas?

WHILE most of us have had ideas, very few of us act on these ideas. A slight rebuff, or lack of an opportune moment, will make us quit.

It's a curious fact, but sometimes the very person using a great deal of creativity in developing an idea will show absolutely no imagination in presenting the idea to his supervisor.

How can you prepare to present ideas? First you have to realize that the "gold" you see in your idea won't shine as brightly to another person—hence an automatic resistance to the idea.

Almost all of us meet resistance to new ideas. We should learn to expect resistance, and plan for it. Instead of rushing in to your boss with your "Eureka," take time to prepare it a little more. Work out some of the bugs.

Test your idea on a fellow worker. Ask him to act as a "judicial" or antagonistic listener to find the weak spots in your idea. The results of such a conference will give you a chance to eliminate holes in your idea, and allow you to prepare in advance for the questions your boss might ask.

Get to know and understand the person to whom you plan to present the idea. Try to figure in advance what the best plan or technique of presentation will be for this person. Items to consider are:

1—**Timing?** If your man has indigestion immediately after lunch, wait until later in the day. Also don't be surprised if he seems rushed and uninterested while in the midst of annual reports and budget making.

2—**Personal presentation?** You might get a long service coworker's ideas or advice before you present your idea to your boss.

3—**Gradual presentation?** If your idea is radical, or extensive, you might meet resistance by showing it all at once. In this case you can present it piecemeal, in logical order, to build an acceptance background for the material to follow.

4—**Verbal presentation?** Busy administrators often lay aside memos which are not pressing. But if you give verbal summaries, they will watch for the memo.

How Can Management Encourage Ideas?

A COMPANY wanting to encourage ideas must first consider the idea source—the employe.

Cynicism and indifference by management will kill ideas. The "practical" executive who prides himself on spilt-second judgments can squash an "off the beaten track" idea.

Too many ideas are killed by deadly phrases such as "The boss will scream," "We tried that before," "We've never done it before," and "Let's take it up later." A good rule to follow is, "It will be illegal to object to any idea on the same day it is presented."

On the other side, employes have definite ideas of what they should gain by having ideas. These include money, personal satisfaction, doing a better job, and promotions.

Therefore, if your company wants to encourage employe ideas, it needs:

1—An easily available listener.

2—An open-minded listener.

3—Recognition and reward for good ideas.

Never should an employe be ridiculed for a "wild" idea.

Brainstorming—Group Ideas

Brainstorming is a group "free association" idea session. The group tries to produce a large number of spontaneous ideas in a short time.

Problem definition will control the success of the group session, just as it will for an individual idea-making session. General problems produce vague ideas—specific problems limit the scope of ideas. An ideal problem is defined generally enough to allow free ideation, yet prevent wandering.

Rigid rules must be observed during the brainstorming session to keep it from degenerating into a "free-for-all." These rules will vary from group to group, but the following have proved effective:

- **Equal rank.** The presence of "brass" makes some participants self-conscious.
- **Proper group size.** A large group causes a traffic jam with members speaking simultaneously. A small group lacks the variety of background needed for cross-pollination of ideas. Recommended size is 9-12 members.
- **Problem statement.** Made by the chairman at the start of the session. Problem should be clear.
- **Spontaneity.** Members speak out with ideas as soon as conceived.
- **No criticism allowed.** Attempts to evaluate or judge ideas during the session will stop the free flow of ideas.
- **A bell rings.** The chairman uses a bell to signify any member is out of order or tries to be "judicial."
- **Ideas are recorded.** A large blackboard is used to record all ideas within plain sight of the session.
- **Ideas are associated.** Members try to combine or modify previous ideas to form new ideas.
- **Sessions are short.** Brainstorming should be limited to about 45 minutes.

Idea evaluation is usually made the following day by an executive with or without the aid of the brainstorming group.

Large groups may brainstorm by Method 66 (sometimes called the Phillips 66 Method). A large group is divided into smaller groups, each having about 6 members. The smaller groups then brainstorm the problem individually. The best idea from each group is then presented to the over-all group.

Creativity Training Courses

Creativity teaching is relatively new, and not too much has been published on the subject. Ethyl Corp. will consult with any petroleum refining company interested in starting a creativity course, and Osborn's book[1] and instructor's guide have been used in many courses. Also the Creative Education Foundation, Inc.—founded by Osborn—at 1614 Rand Bldg., Buffalo, N.Y., will assist companies planning creativity courses, and advise them as to adult evening school courses teaching the subject.

Schools, including the Massachusetts Institute of Technology (Prof. John Arnold) and Pennsylvania State College (Prof. Morris Gjestahl), conduct summer seminars on creative engineering which may be of value.

References

(1) Osborn, Alex F., "Applied Imagination" and instructors guide, 1953, Charles Scribner's Sons, New York City, $3.75.

(2) Platt, W. and R. A. Baker, "The Relation of the Scientific Hunch to Research," *Journal of Chemical Education*, Oct. 1931, pp. 1969-2002—limited number of reprints available from C. H. Clark at Ethyl Corp., NYC by company letterhead requests.

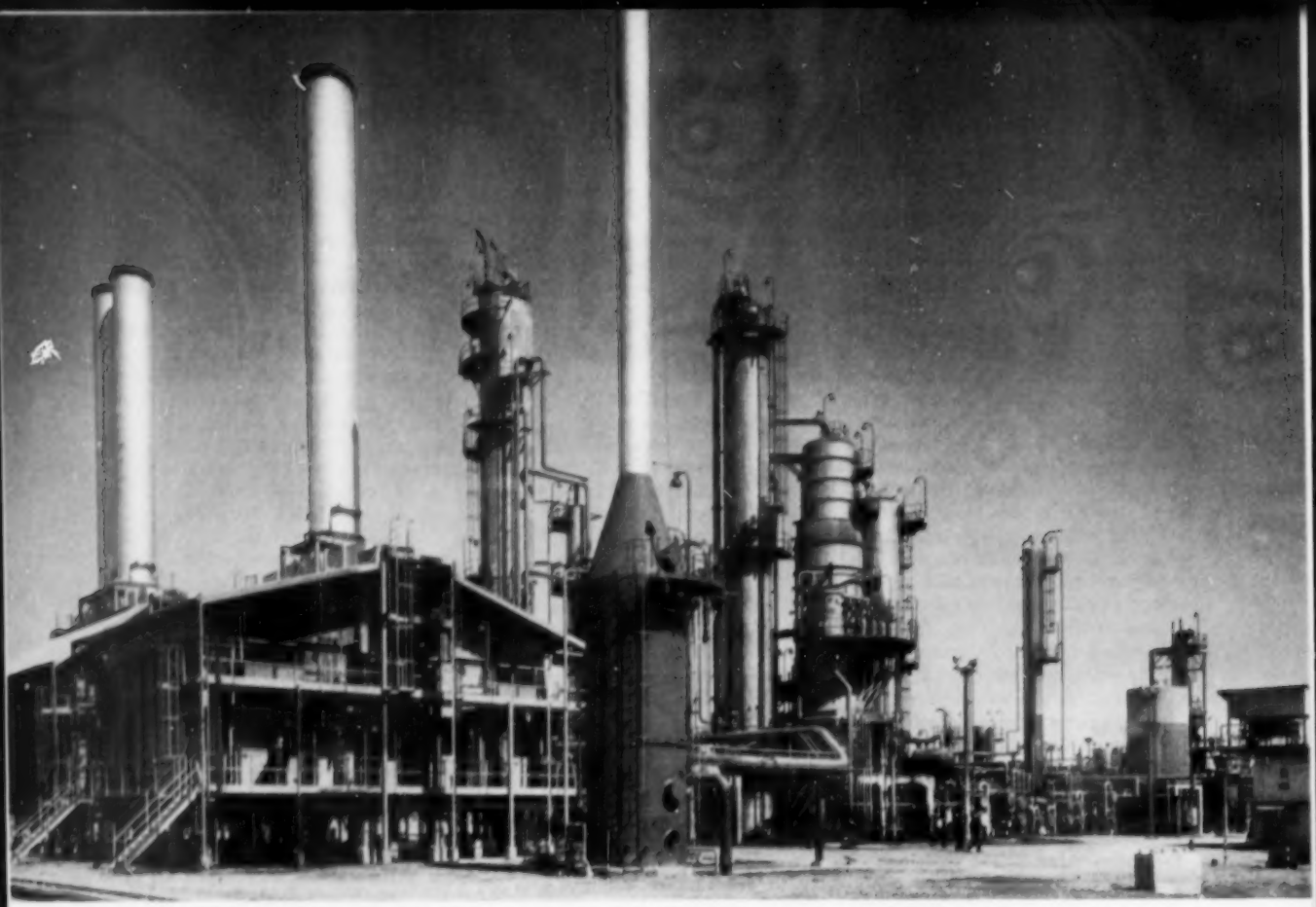
(3) "Imagination—Undeveloped Resource: A Critical Study of Techniques and Programs for Stimulating Creative Thinking in Business," study by a Harvard Business School student research team—has 65 references from General Electric Co.'s creative engineering course—available from Charles Whiting, 200 W. 58th St., New York 19, N. Y., $7.50.

About Charles Clark

Charles H. Clark, assistant to the Manager of Training, Industrial Relations Department, at Ethyl Corp., joined Ethyl in this capacity in June, 1953.

Mr. Clark, born in Philadelphia, Pa., in 1920, has spent several years in research on his specialty, a course in "Creative Thinking," and he assisted in the preparation of Alex Osborn's book[1] immediately after getting a master's degree in education (1952) from the University of Pennsylvania. Prior to that, he received an A.B. degree from Harvard (1943), and served as a specialist interviewer for the U.S. Navy from 1944 to 1946.

In addition to the "Creative Thinking" course, Mr. Clark delivered his talk on "Creative Thinking" to many groups during 1955.



COMBINATION TOPPING AND CRACKING at Baghdad is designed to turn 24,000 b/d of crude into five major products

Combination Unit Lowers Costs At New Baghdad Refinery

*By Dr. NADHIM AL-PACHACHI, ATA AMIN, MOHAMED AL-NAQUIB, IHSAN RIFAT, and Staff**

ONE PLANT for five major operations—crude distillation, visbreaking, cracking, reforming, and vacuum flashing—lowers operating costs very considerably at the Iraq Government's new 24,000 b/d Daura refinery, near Baghdad. Biggest savings are in capital investment, utilities, and labor. Operating flexibility is excellent.

Products from the 36° API Kirkuk crude are gasoline, kerosene, and gas, diesel, fuel, and Bunker "C" oils. See table on page 60 for product yield percentages at 112% of design capacity, and typical finished product inspections.

How the combination unit works: The simplified flow diagram shows how processing operations are integrated in the M. W. Kellogg Co.-designed combination unit which went on stream in mid-1955. These are: crude oil distillation, naphtha reforming, once-through visbreaking, heavy gas oil cracking, gas recovery, gasoline stabilization, and intermediate fractionation.

The crude heating furnace is the first stop for the feedstock after it picks up preheat by exchange. The required fraction is vaporized at about 630°F and the stream is then fed to the crude tower.

* H. E. Dr. Nadhim Al-Pachachi is Minister of Economics of Iraq. H. E. Ata Amin is Chairman of the Board of the Government Oil Refineries Administration. Mr. Mohamed Al-Naquid is Director-General of the Board. Mr. Ihsan Rifat is Chief of the Technical Section, and Director-General of Oil Affairs. Members of the refinery staff are: Jefferson W. Mitchell, general manager; Alfred R. Guest, assistant general manager; Melbourne G. Fryback, chief process engineer.

In the tower, the crude is fractionated into a light straight run naphtha overhead, and four liquid side streams: heavy straight run naphtha, kerosene, light and heavy virgin gas oils, and a reduced crude bottoms stream comprising approximately 40% of charge. The four liquid side streams pass on to the crude stripper tower where the front end properties are controlled by steam stripping.

The corrosive acidic elements passing overhead along with the light hydrocarbon vapors are neutralized by ammonia injection. The light straight run naphtha overhead stream is fed to the stabilizer along with cracked motor spirit from the bubble tower overhead.

The heavy straight run naphtha side stream is pumped to the reformer coil for octane up-grading. The stripped kerosene of 100-110°F flash point is cooled and delivered to intermediate storage before treating. The light and heavy gas oils are cooled and supplied in the required blending proportions to make gas oil and diesel oil.

Reduced crude is pumped from the bottom of the crude tower to the visbreaking furnace for required viscosity and pour point reduction.

The three furnace outlet streams containing gas, gasoline, gas oil, and tar, after quenching, are fed into the flash section of the two-section evaporator tower, where the first separation is made between the gas, motor gasoline, gas oil, and the heavy residue. The heavy residue is pumped off the bottom to the vacuum flash tower for final removal of any light ends.

Liquid from the trapout pan separating the section of the evaporator tower, is the charge to the gas oil cracking coil. Several intermediate refluxes assure supply of clean vapors to the trapout pan. Their sources are the bubble tower bottoms stream of cracked gas oil and the light and heavy flash distillates of the circulating reflux streams at the vacuum flash tower. In the gas oil trapout pan, fractionating trays and stripping steam prevent the inclusion of any light ends in the gas oil cracking charge.

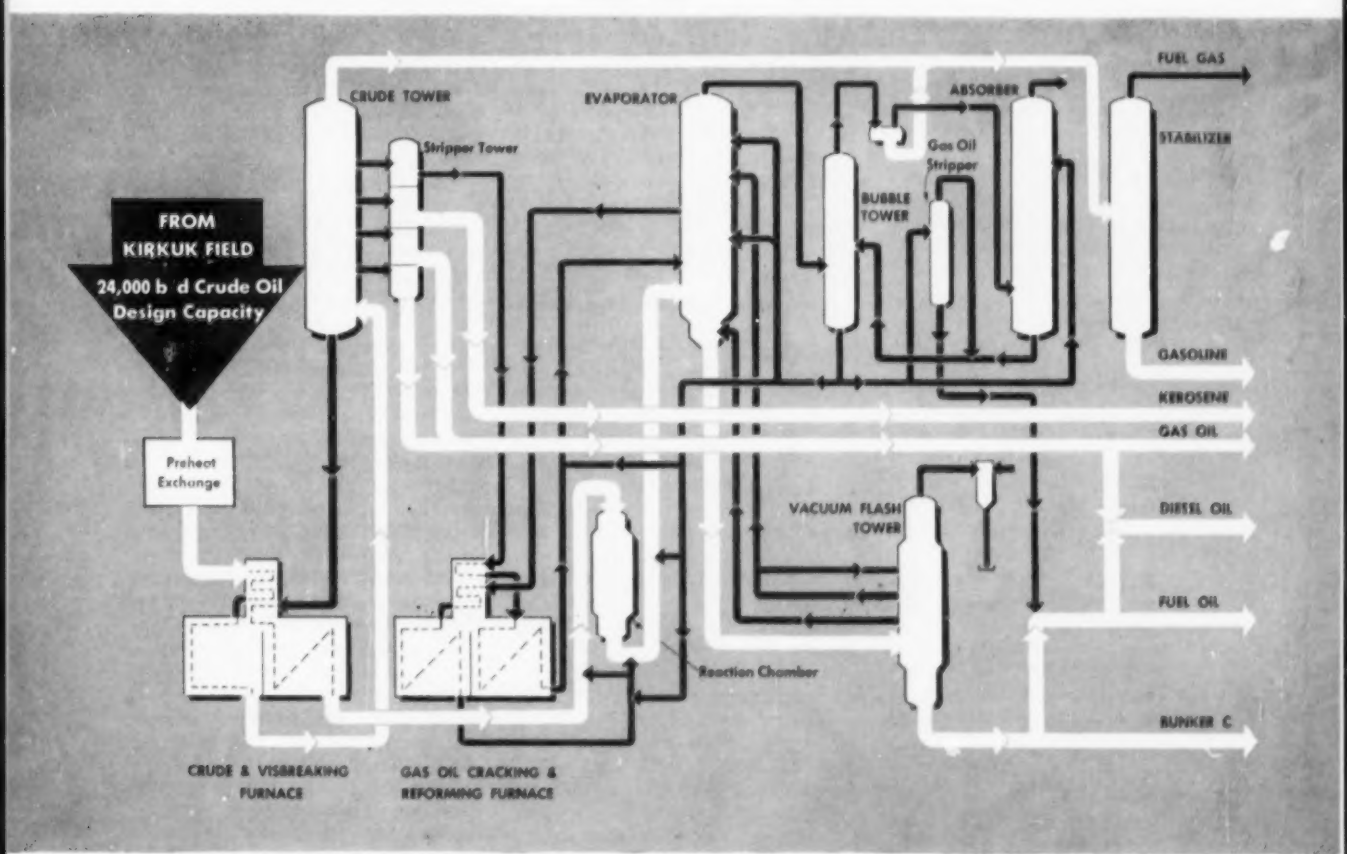
The overhead from the evaporator —gas, gasoline, and light gas oil— passes to the bubble tower for additional fractionation. The heavy residue from the bottom of the evaporator is flashed in the vacuum flash tower to remove the last traces of the more valuable lighter components.

The vapors flashed off are condensed and separated into two fractions, a light flash distillate and a heavy flash distillate which are sent back as circulating reflux and as intermediate reflux to the evaporator. The non-condensibles and steam pass on overhead to the jets.

The vacuum flash tar bottoms are cooled and sent to tankage for later blending to a heavy residual fuel oil or Bunker "C" fuel.

From the evaporator tower the overhead vapors pass directly to the bubble tower where they are fractionated into an overhead gas and motor gasoline fraction and a bottom cracked gas oil cut. To supply intermediate reflux, the bottoms are recycled as well as the combined stream of the rich oil from the absorber and the light cracked gas oil overhead from the gas oil stripper.

The overhead vapors from the bubble tower are partially condensed. The cracked motor gasoline condensate



KEROSENE TREATING capacity is 4400 b/d

SULFURIC ACID RECOVERY from sludge is 7 ton/day

joins with the light straight run naphtha as charge to the stabilizer. The uncondensed vapors are fed to the absorber for recovery of the required amount of butanes needed for vapor pressure adjustment of the motor gasoline.

The bottoms from the bubble tower, after exchange to provide the reboiler duty for the stabilizer, separate into many streams. Among these are the charge to the gas oil product stripper, lean oil for the absorber, gland oil, flushing oils to instruments and valves, quenches, and the previously mentioned refluxes for the evaporator and bubble tower.

In the cracked gas oil stripper, the charge is steam-stripped over four trays for flash control of the heavy cracked gas oil which is used as a blending stock.

The gas feed to the absorber is counter-currently extracted in a 30-tray column of the required butanes and heavier to meet vapor pressure requirements on the motor gasoline. The unabsorbed gas passes out to the fuel gas system.

The combined stream of light straight run naphtha and cracked gasoline is fed to a 24-tray stabilizer. Gasoline of desired vapor pressure is pumped from the bottom to intermediate tankage before treating. Top reflux is provided from partial condensation of the overhead vapors. The uncondensed vapors are released to the fuel gas system.

Two floor-fired furnaces supply the crude preheat and the heat to the visbreaker, reformer, and cracking coils. Crude preheat and visbreaker coils are contained in one furnace while the second furnace houses the reforming and cracking coils. Both furnaces are equipped to burn either, or both, fuel gas and heavy residual fuel oil.

Treating: The 6,200 b/d gasoline treating unit provides caustic washing, regenerative caustic treating, copper

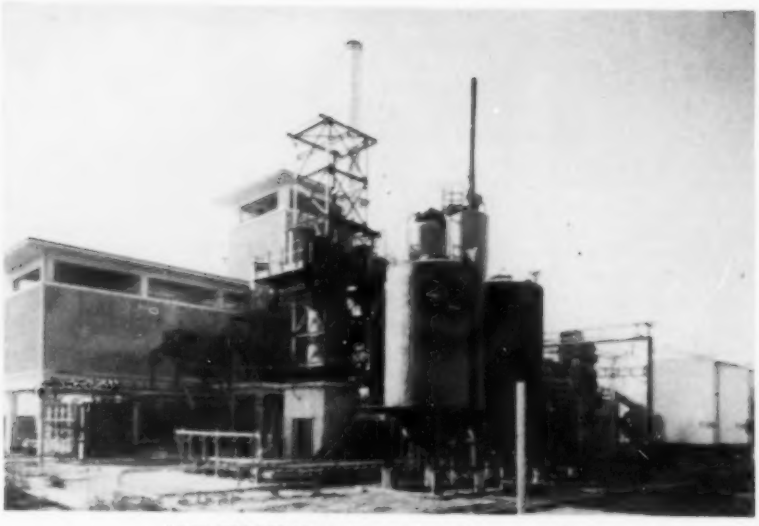
Baghdad Combination Unit Yields and Typical Product Inspections

	b/sd	Liquid Vol.-% of Charge
Charge:		
Stabilized Full Range Kirkuk Crude	27,000	100.0
Products:		
Motor gasoline	6129	22.7
Kerosene	5643	20.9
Gas oil	3807	14.1
Diesel	(1)	(1)
Fuel oil	9342	34.6
Bunker "C" oil	1053	3.9
Gas and loss	1026	3.8
	27,000(2)	100.0

(1) Fuel oil and gas oil are tank blended to make diesel oil according to market demand.
(2) Yields from operations at 112% of design capacity.

Typical Finished Product Inspections

	Motor Gasoline	Kerosene	Gas Oil	Diesel Oil	Fuel Oil	Bunker "C" Oil
Gravity, °API	68.1	47.5	37.4	29.2	20.3	11.9
Distillation:						
IBP	99	284	369			
10%	126	331	446			
30%	160	354	500			
50%	199	379	530			
70%	237	414	561			
90%	288	464	604			
E.P.	338	504	644			
Flash point, P-M, °F	—	108	174	180	185	200+
Sulfur, wt.-%	0.07	0.10	1.0	2.0	3.5	4.4
Reid vapor pressure, psi	8.0	—	—	—	—	—
Viscosity:						
Redwood 1 @ 100°F, Sec.	—	—	35	57	200	—
Redwood 2 @ 122°F, Sec.	—	—	—	—	—	250
Pour point, °F	—	—	10	20	25	75
Color	—	25(Saybolt)	2.0 NPA			
Carbon residue, wt.-%	—	—	.02	2.0	8.4	11.6
Diesel index	—	—	62	—	—	—
Octane:						
Motor	74					
Research	78					



ACID TREATING section of the kerosene unit

sweetening and inhibiting, and metal deactivator injecting.

The 4,400 b/d kerosene treating unit consists of a sulfuric acid contacting section, a caustic neutralizing section, and a clay contacting section.

Operating flexibility was demonstrated recently for the combination unit when market conditions required decreased production of gasoline and Bunker "C." Gas oil cracking severity was reduced to practically nothing by passing the gas oil through the cracking coils only for protection against overheating. This solved the immediate problem and at the same time provided useful middle distillate stock.

A more elaborate solution—tailoring the crude at the producing field—was designed later. So as not to lose the octane advantage of the light front end, only a portion of the crude was deep stabilized, removing the IBP-350°F fraction. This fraction was then blended with full crude to provide a tailored feedstock with about half as much straight run gasoline, but still retaining the entire boiling range of stabilized full crude.

Other facilities: The refinery is designed to be self-supporting. It supplies its own utilities, plant maintenance, and fire and medical services.

The important operating units other than the combination unit are: sulfuric acid plant; power plant for steam and electricity; two water treatment plants —for process water and for drinking and boiler feed water; and a complete canning plant which makes, paints, labels, fills, and seals the cans in which the refined products are shipped.

Sufficient tankage has been provided to avoid limiting operations because of inadequate storage facilities. Capacity for crude is 428,000 bbl; for products, 994,000 bbl; for intermediate storage, 256,500 bbl.

The sulfuric acid plant is the "Chemico" process type. It uses vanadium pentoxide as a catalyst for the conversion of sulfur dioxide to sulfur trioxide. Acid can be produced by burning raw sulfur, to provide about 18 t/d, and/or by recovery from acid sludge, providing about 7 t/d. Both methods can be used simultaneously.

The main water treatment plant is supplied from the Tigris River at an average rate of 3,000 gpm. After being cleared by two clarifloculators the water goes to a 4-section main reservoir of 3-million gal. capacity, from which it is passed by a pair of 2,500 gpm motor driven pumps throughout the plant and to the cooling system. Process cooling water is moved by three condensing-turbine driven 15,000 gpm pumps.

The 30,000 gpm cooling tower is the all-film flow, induced draft type. It is divided into five cells.

A 900 gpm plant in the power plant provides drinking water.

The power plant provides steam for all steam consuming equipment in the refinery, including its own turbine-driven electric power generators. Four boilers, each of 75,000 lb/hr capacity, generate steam at 265 psig and 500°F. Refinery Bunker "C" oil, gas oil, and fuel gas are used as fuel.

Three condensing turbo-alternators of 2,000 kw capacity generating at 3,300 v, 50 cycles, supply five high tension sub-stations. Low tension power is 380 v, 3-phase; lighting voltage is 230.

Compressed air is supplied at 100 psig by three motor driven compressors. 200 cfm of instrument air is dried; all air is filtered.

The canning plant is currently shipping about 170,000 cans per month. The product shipped in largest volume is gasoline, followed by kerosene and gas oil. Mechanized handling, with conveyors and lift trucks, is used wherever possible. As throughout the rest of the refinery, safety is stressed in the canning plant. Vapor pull off at the filling nozzles and room air change are provided by a building blower system. A fog-head sprinkler system provides fire protection.

Fire protection is well organized. Units are spread out and tanks are diked. Six fire houses stock equipment. An alarm system is built into the plant telephone network. The 4 men shift on duty at the main fire house where the fire truck and trailer are stored can be aided by auxiliary firemen.

The Daura site was picked for three reasons, although it is oversize for the refinery's needs. These include: closeness to Baghdad, plentiful water supply, and convenient water transportation. Baghdad is Iraq's largest petroleum product consumer. In 1954 it accounted for 40% of the nation's consumption of over 6.6-million barrels. Baghdad is also the nation's oil product distribution center.

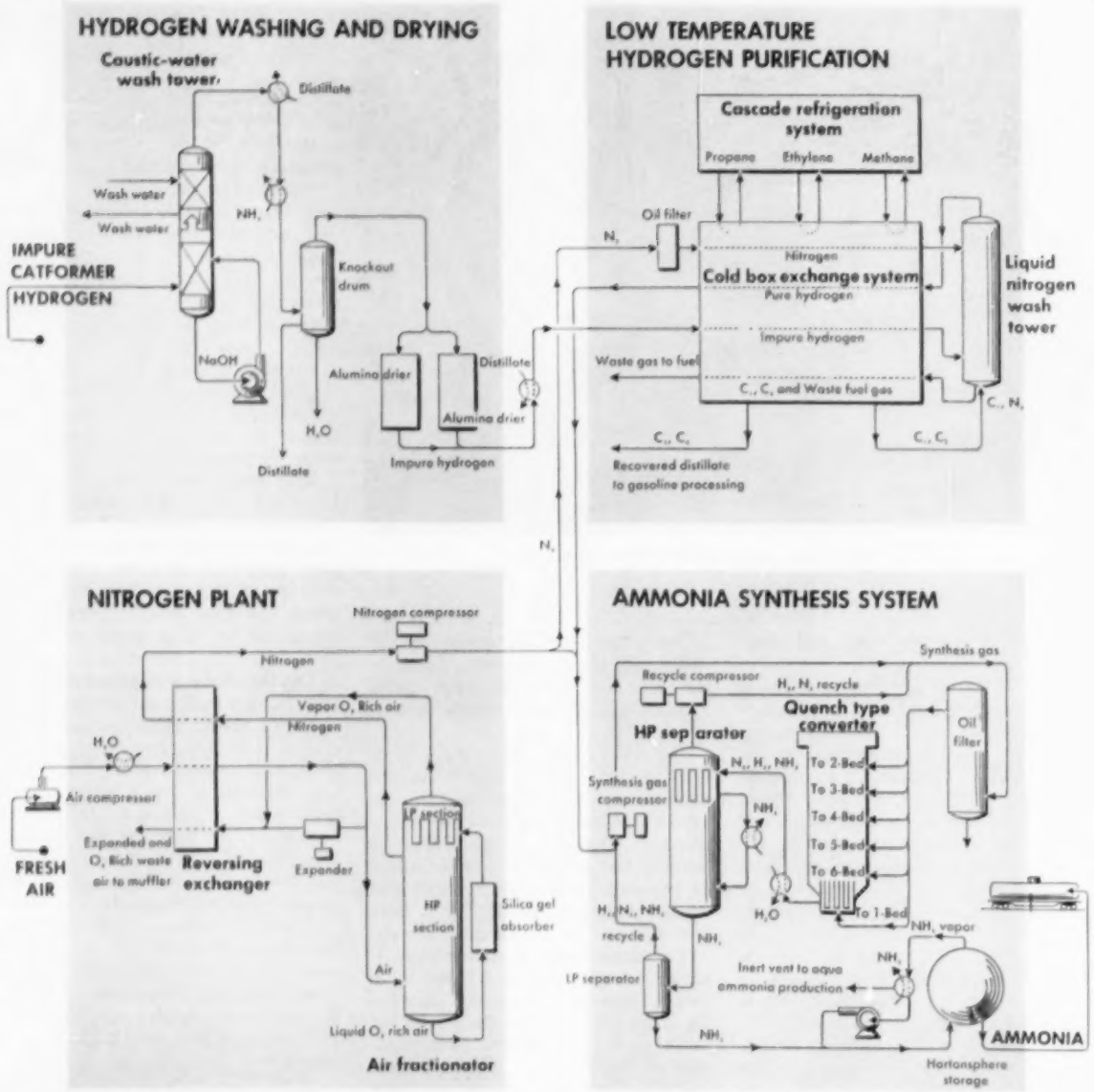
Crude oil comes from the Iraq Petroleum Co.'s Kirkuk fields, 180 miles away. The 36° API Kirkuk crude, with sulfur content of 2.0%, is brought in through a specially-built, 130-mile pipe line with a 45,000 b/d capacity.

More than 80% of the refinery's equipment is British. Concrete work was done by D. & C. and William Press Co. Ltd. Maunsel, Posford, Pavery Co. handled the civil engineering. Power plant engineering was by Cyanamid Products Ltd.

The plot plan is arranged so that additional units and equipment can be easily added. Foster-Wheeler Ltd. is already building a 500 b/d lube oil plant on the site. The Government Oil Refineries Administration has announced that the country's gasoline octane number will be raised from its present 80. It is considering going to catalytic reforming for future octane upgrading.

Picture Credits

The Photographs illustrating this article, furnished to PETROLEUM PROCESSING by M. W. Kellogg Co., were made by Elwood M. Payne.



ANHYDROUS AMMONIA PLANT showing hydrogen and nitrogen preparation and ammonia synthesis steps

From By-Product Hydrogen to Anhydrous Ammonia

By J. H. ARNOLD, Consultant, Hydrocarbon Research, Inc., and W. T. DIXON, The Atlantic Refining Co.*

Here is the complete story on the 100 ton/day plant at Atlantic Refining Co.'s Philadelphia refinery, in operation over a year and a half. Unusually pure synthesis gas permits manufacture of refrigeration grade ammonia with no purging of inerts during operation. Pressures run below 3000 psig.

* Present address, 174 Blackburn Road, Summit, N.J.

THE first plant built in this country to make anhydrous ammonia from catalytic reformer by-product gas has now been onstream about 1½ years. Several features make this plant unique, such as relatively low pressure for ammonia synthesis, combination cold-box for hydrogen purification and nitrogen separation, and operation without purging of inerts.

Designed and constructed by Hydrocarbon Research, Inc., the plant produces a nominal 100 ton/day anhydrous ammonia at the Atlantic Refining Co.'s Philadelphia refinery.

Though anhydrous ammonia is its single primary product, the plant also recovers propane and heavier hydrocarbons from the by-product gas as a liquefied stream, and the lighter hydrocarbons as fuel gas.

Gas used as a source of hydrogen comes from an Atlantic Catformer, a catalytic reforming process developed by the Atlantic Refining Co. to produce high-octane gasoline from low-grade naphthas. The two Catformer gas analyses shown in the table were used as bases for design of the ammonia plant.

Actual Catformer gas generally has been richer in hydrogen than *Case A* analysis. With this feed, the production rate has well over 100 ton/day. At other times, the plant has operated on gases which approach the lower hydrogen of *Case B* in the table.

Plant Description

Process equipment is divided into three main functional groups: nitrogen separation, hydrogen purification, and ammonia synthesis and recovery.

The two basic steps in the preparation of the synthesis gas, the fractionation of nitrogen from air and the washing of the Catformer gas with liquid nitrogen, are both carried out in a single, compact cold box. The two sections are designed to operate indefinitely without deriming.

Nitrogen for washing the hydrogen and for synthesis of ammonia is separated from air by liquefaction and distillation at low temperature.

Ammonia synthesis, from the mixture of hydrogen and nitrogen, is effected at a relatively low pressure over a typical doubly promoted iron catalyst in a single converter at pressures below 3000 psig.

The ammonia product is liquefied by cooling the synthesis reactor effluent to 100°F. in two stages using water, and to 25°F. using ammonia refrigeration. The liquefied ammonia product flows directly from the recovery system to the product storage.

Synthesis gas prepared from the Catformer gas is so pure that the small quantities of other gases which it contains are soluble in the liquid ammonia leaving the 400 psig let-down tank.

The hydrogen separation plant is also designed to process a blend of water gas and Catformer gas.

The 97% conversion of hyrogen in Catformer gas to a refrigeration grade liquid ammonia product is made possible by eliminating the need to purge converter recycle, and by the use of a simple, pressure-tight system.

The only major equipment provided in duplicate are the acetylene adsorbers, and the Catformer gas driers.

The feed air compressor of the nitrogen separation plant and the recycle gas circulating compressor of the ammonia synthesis plant are each single units. Other large compressors are provided as two half size units.

No spare cold equipment is provided for deriming the exchangers in the hydrogen separation plant nor are these operated on a switch basis.

There is a single ammonia synthesis converter and a single ammonia recovery system including a single high-pressure separator.

Utilities— The compressors which consume the bulk of the power required to operate the plant are driven by electric motors. The larger compressors are driven by unity power factor synchronous motors.

The total electrical load is approximately 4000 kilowatts. The steam requirement is under 2500 lb./hr. and the circulating cooling water rate is under 4000 gal./min.

Plant Layout—The plant is situated on a plot 176 by 274 ft. There are two buildings; the larger building houses the compressors and some of the associated intercoolers, aftercoolers, and drums. The smaller building shelters principal control instruments and synthesis converter valve operators. All other equipment is outdoors.

Nitrogen Separation

Air to be liquefied and fractionated in the nitrogen separation plant is drawn from the atmosphere.

The air is filtered and then compressed to approximately 80 psig in a seven-stage, diaphragm-cooled, centrifugal compressor driven through a gear by a synchronous motor.

This compressed air is cooled in a conventional water cooled tube and shell exchanger and the water condensate is separated in a vertical drum which also acts as a surge drum.

Reversing exchangers are used to further cool the compressed air to essentially its liquefaction temperature and to remove the water and CO_2.

The chilled compressed air is liquefied and distilled in a fractional distillation column at approximately 68 psig into a high purity gaseous nitrogen stream overhead and an oxygen enriched liquid bottoms.

Liquid bottoms are subcooled external to the tower, passed through silica gel to remove traces of acetylene and then expanded into a condenser-evaporator at the distillation tower.

The expanded liquid vaporizes completely in the condenser-evaporator, thereby condensing nitrogen reflux at the top of the distillation tower.

Nitrogen product from the top of the distillation column and the waste both flow out the reversing exchanger, chilling incoming compressed air.

Every 15 minutes, the flow of compressed air and of waste gas through the reversing exchanger is reversed; i.e., the compressed air is caused to flow through the passes previously carrying waste gas and the waste gas is caused to flow through the passes previously carrying compressed air. In this manner the residual water and carbon dioxide deposited from the compressed air during one half cycle are revaporized into the waste gas and carried out of the exchanger during the next half cycle.

High purity nitrogen flows through the special nonreversing passes of the reversing exchanger to prevent contamination with air or waste gases.

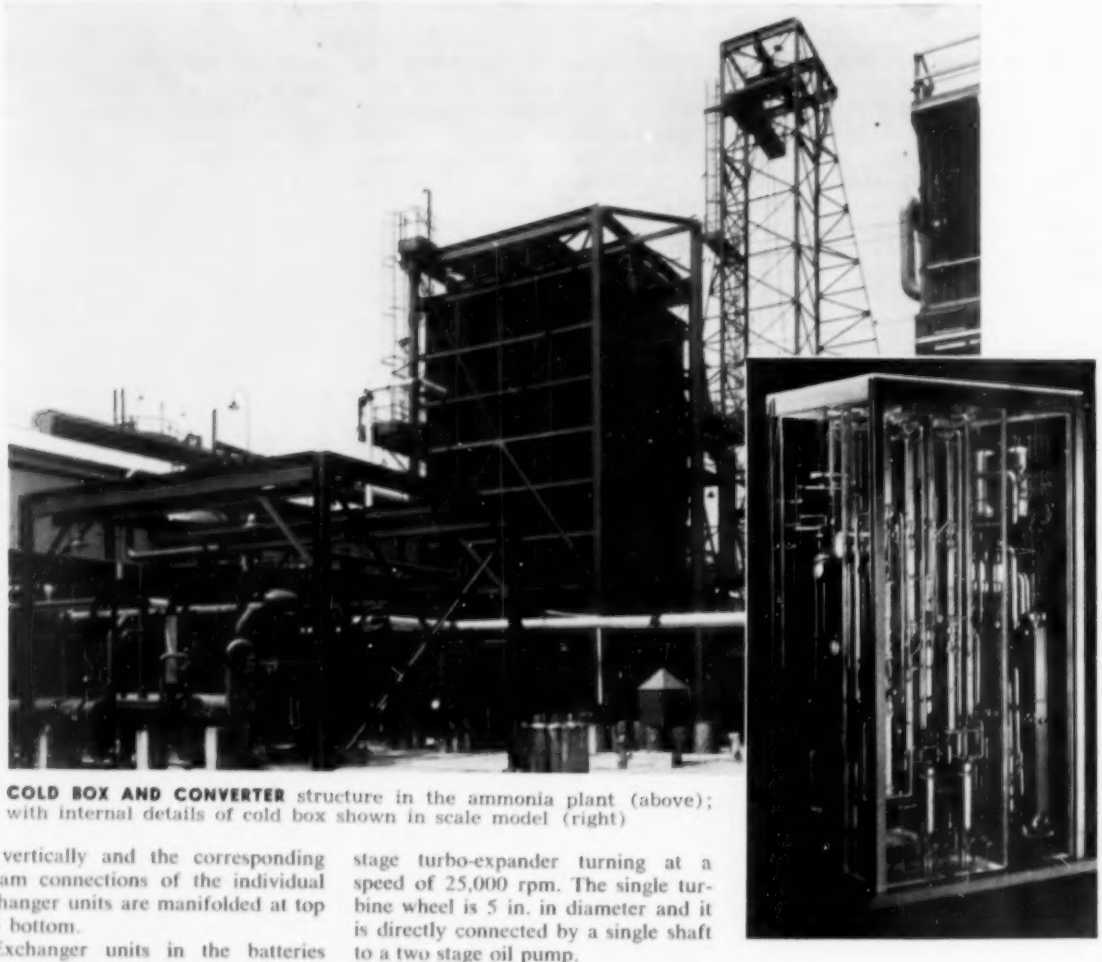
The reversing heat exchanger assembly consists of a number of brazed aluminum extended surface heat exchanger units manifolded into batteries. Each battery has three exchanger units in parallel and two exchanger units in series.

Each exchanger battery is mount-

Approximate Compositions of Catformer By-product Gas

(As used by Atlantic)

	Case A	Case B
Flow Rate, SCFD	8,000,000	8,000,000
Components:		
H_2S, grains/100 cf	10	10
H_2, mol%	95.0	86.6
CH_4, mol%	0.6	3.2
C_2H_6, mol%	0.6	2.5
C_3H_8, mol%	1.9	4.6
iC_4H_{10}, mol%	0.7	1.2
nC_4H_{10}, mol%	0.5	0.9
iC_5H_{12}, mol%	0.2	0.4
nC_5H_{12}, mol%	0.1	0.2
C_6+, mol%	0.4	0.4
Totals	100.0	100.0



COLD BOX AND CONVERTER structure in the ammonia plant (above); with internal details of cold box shown in scale model (right)

ed vertically and the corresponding stream connections of the individual exchanger units are manifolded at top and bottom.

Exchanger units in the batteries have cross sections of 17 by 20⅞ in. and lengths of 106½ in. There are 50 individual passes per exchanger, divided between the streams exchanging heat in accordance with needs.

Each exchanger pass has 15 fins/in. of width running the length of the pass. The fins are 0.375 in. tall and 0.008 in. thick and they are both corrugated and serrated.

The distillation column has an internal diameter of 54 in. and is approximately 34 ft. tall. The shell and heads are fabricated of stainless steel and the trays, bubble caps, and downcomers are of aluminum. The tray spacing is 4 in. and the tray seals are specially designed to avoid bypassing of the trays by even minute quantities of gas which adversely affect the purity of the product. The condenser-evaporator at the top of the tower consists of light drawn copper tubes rolled into stainless steel tube sheets.

The refrigeration requirement of the nitrogen separation plant is supplied by expanding chilled air from approximately 72 psig and minus 245°F. to about 4 psig and minus 307°F.

The air is expanded through a single stage turbo-expander turning at a speed of 25,000 rpm. The single turbine wheel is 5 in. in diameter and it is directly connected by a single shaft to a two stage oil pump.

The first stage is a jet pump used primarily to force lubricant through the bearings. The second stage is a single impeller used primarily to absorb power. The single shaft is less than 12 in. long.

Power is generated at one end at temperatures well below minus 200°F. and absorbed at the other end at temperatures above plus 100°F. The combined turbine and pump assembly is about 30 in. long, 10 in. in diameter, weighs less than 50 lb. and can develop and absorb over 40 HP.

Cold Box Details—All equipment of the nitrogen separation plant is enclosed in a rectangular box made of structural steel with sheet steel sidings. The space within the box not occupied by equipment is packed with mineral wool.

Bonnets of all operating valves extend through the cold box wall so that the valves can be repacked without entering the cold box.

Conventional instruments are used throughout with essentially all the working parts mounted externally.

Essentially all of the equipment inside the cold box, exclusive of the condenser-evaporator tubes, is either stainless steel or aluminum.

Special transition joints similar to Van Stone flanges are used for aluminum and stainless steel connections.

Hydrogen Separation

The Catformer gas arrives at the ammonia plant at ambient temperature and approximately 400 psig.

First processing removes hydrogen sulfide and water vapor which would otherwise solidify in the cold exchangers of the hydrogen separation plant.

Hydrogen sulfide is removed from the gas by caustic washing in the lower section of a double tower, with any caustic entrainment removed by water washing in the upper section.

Hydrogen sulfide free gas is then partially dried by refrigerating to 50° F. and further dried over activated alumina to a dew point of minus 80°F.

The gas, free of hydrogen sulfide and water, is cooled in a series of brazed aluminum extended surface exchangers and washed with liquid nitrogen.

Hydrocarbons condensing from the

gas as it is chilled prior to the nitrogen wash are removed from the gas in four separators at four temperature levels. The liquids from the first two separators are blended to form the by-product liquid mixture of propane and higher hydrocarbons. The liquid from the last two separators are evaporated into the by-product fuel gas.

Nitrogen leaving the nitrogen separation plant is boosted to about 400 psig in two stages of a multicylinder reciprocating compressor directly coupled to a synchronous motor.

The portion of the compressed nitrogen to be liquefied for washing hydrogen is cooled in some of the same brazed aluminum exchangers used to cool the Catformer gas.

The chilled Catformer gas enters the nitrogen wash tower just below the bottom tray. Liquefied nitrogen enters the tower on the top tray.

Washed hydrogen leaves the top of the tower as a vapor essentially free of hydrocarbons and oxygen but containing about 10% of nitrogen.

Condensed hydrocarbons and residual liquefied nitrogen leave the bottom of the tower as a liquid mixture and are vaporized into the by-product fuel gas external to the tower, thereby furnishing refrigeration to liquefy a part of the nitrogen used for washing and to help cool the Catformer gas.

The exchangers used to cool the Catformer gas and the nitrogen to be liquefied are similar in construction to the reversing exchangers described for the nitrogen plant though smaller.

Twenty-seven individual exchangers are manifold in series and in parallel as required by the flow and duty of each step of the cooling and multiple stage separation of the hydrocarbon condensates.

The nitrogen wash tower has an internal diameter of 2 ft. and is approximately 28 ft. tall.

Shell and heads are fabricated of stainless steel and the trays, bubble caps and down comers are aluminum.

Tray spacing is 8 in. and tray seals, like the tray seals of the nitrogen separation tower, are specially designed to avoid bypassing of the trays by even minute quantities of gas which would affect product purity.

Refrigeration and Compression— A cascade refrigeration system provides the net refrigeration requirement for cooling the Catformer gas, condensing the hydrocarbons from the Catformer gas, and cooling and liquefying the nitrogen used for washing.

Steps of the cascade system are propane, ethylene, and methane. Each refrigerant is compressed in two stages using two cylinders of a six cylinder reciprocating compressor directly driven by a synchronous motor.

A single 450 HP machine handles all three services. Two identical 450 HP machines are provided, each designed for one half total load. Thus when operating on Case A feed, one machine can be shut down.

Each refrigerant is vaporized at a slight positive pressure. Refrigeration is utilized at all temperature levels.

Refrigeration at the propane and ethylene levels is utilized principally to condense hydrocarbons from the Catformer gas. Refrigeration is used at the methane level to liquefy nitrogen.

Refrigeration output of each system is automatically controlled to meet normal fluctuations in load. Clearance pockets are also provided.

The cascade compressor cylinders are lubricated with a high grade petroleum oil and special traps are used to remove oil entrained in the refrigerant before it enters the sub-atmospheric temperature section of the cascade.

Cold Box Details—The equipment of the hydrogen separation plant, including the refrigeration cascade, operating at sub-atmospheric temperatures, is enclosed in the same cold box which encloses the nitrogen separation equipment. The two sections are separated by an internal partition which permits access to one section without disturbing insulation in the other.

Ammonia Synthesis

The entire output of washed hydrogen from the hydrogen separation plant plus the necessary pure nitrogen are mixed to form a 3:1 hydrogen nitrogen synthesis gas, and the mixture is further compressed in two stages in two cylinders of the multicylinder reciprocating compressor, the other cylinders of which are used to compress pure nitrogen to about 400 psig.

The synthesis gas does not normally contain any significant content of free oxygen or carbon monoxide. However, as a precautionary measure the synthesis gas, as it leaves the first stage of the compressor, is heated by steam in a conventional tube and shell exchanger to approximately 400°F. then flows through a guard chamber with reduced copper nickel catalyst.

Traces of free oxygen or carbon monoxide present inadvertently in the synthesis gas are converted to water vapor and methane respectively and thus the synthesis circuit is clear of free oxygen or carbon monoxide.

Compressed synthesis gas joins the recycle gas from the ammonia recovery system and enters a specially designed oil filter to remove any compressor lubricating oil entrained by either the synthesis or recycle gas.

The oil free mixture enters the ammonia converter. The bulk of the mixture flows through the heat exchanger located in the base of the converter where it is heated to essentially reaction temperature by the converter effluent.

The preheated mixture flows up the central transfer tube of the converter and then reverses direction and flows down over the catalyst.

Cold gas by-passing the heat exchanger is injected between the vertical beds of catalyst as the main gas stream flows downward over the catalyst thus tempering the reaction and spreading it out over all catalyst beds.

Effluent from the catalyst beds passes through the heat exchanger and on to the water cooler where it is cooled to about 100°F.

The effluent is further cooled to about 25°F. as it flows through an exchanger counter to the cold recycle gas and then through a chiller refrigerated by evaporating ammonia.

Chilled effluent then flows to a separator.

Vapor from the separator, which is the recycle gas, flows back through the cold exchanger and on to the circulator to be returned to the reactor.

The circulator is a single stage reciprocating compressor direct driven by a synchronous motor.

Recycle gas leaving the circulator meets the fresh feed at the entrance to the oil filter and the cycle is completed.

Condensed ammonia from the high pressure separator is flashed to approximately 400 psig in a second separator and the flashed liquid flows under its own pressure to either of two 48 ft. Horton-spheres.

Flashed gas flows to the suction of the synthesis gas compressor and is thus returned to the converter. No purge of inerts is necessary from the synthesis system.

Ammonia product is pumped from storage by means of multi-stage vertical pumps to racks for loading into either railway tank cars or tank trucks.

The ammonia converter has a multilayer steel shell. Top and bottom heads are forgings.

The multi-layer shell serves only as a pressure case for the actual converter. The converter proper has a light alloy steel shell insulated on the outside, and the cold feed gas entering the reactor first flows along the annulus between the inner wall of the pressure case and the insulated outer wall of the alloy shell, to keep the

pressure case cool.

There are six catalyst beds arranged in series vertically and provision is made to add cold gas between all beds which controls the temperature of the gas mixture entering and leaving each bed.

The converter proper and the heat exchanger can be withdrawn as a single unit through the top flange of the pressure case.

An electrical heater is on the converter central transfer pipe carrying hot effluent from the heat exchanger to the entrance to the first catalyst bed. This heater furnishes heat for the initial reduction of the catalyst and to heat the catalyst to reaction temperature whenever the converter is started cold. The heater has a nichrome ribbon element.

Single phase current is supplied to the heater with a maximum power input of 300 KVA. Regulation of power input is afforded by a reactrol transformer capable of varying the voltage across the heating element from 69 volts to 220 volts.

Electrical leads from outside the converter to the internal heater pass through a special pressure cast nonmetallic seal, which is gas tight.

The refrigeration system, used principally to condense the ammonia in the reactor effluent, has two stages of compression with direct contact interstage cooling.

The compressor is direct driven by a 400 hp synchronous motor. Clearance pockets are provided to permit a 25% reduction in capacity. Manual by-pass valves are also provided. Slight variations in load are met by a compensating change in suction pressure.

Design Specifications

The plant is designed to process 8,000,000 SCF/day of Catformer gas and to convert 97% of the hydrogen contained in the Catformer gas.

Also the plant is designed to recover a minimum of 96% of the propane and heavier hydrocarbons as a liquid product. This percentage amounts to 210-430 b/d for the gas in the table.

Nitrogen separation plant design is for nitrogen product containing not more than 25 ppm. of oxygen.

Hydrogen separation plant design is for a washed hydrogen such that the 3:1 hydrogen nitrogen synthesis gas contains less than 10 ppm. of oxygen and less than 100 ppm. of argon and other inerts.

High pressure synthesis equipment of the ammonia synthesis plant is designed for a maximum operating of 3800 psig, but the plant is designed to produce the rated production of ammonia at pressures below 3000 psig without requiring purging the recycle of inerts.

Operating Specifications

The plant controls are designed so that all the available Catformer gas flows into the plant and normal fluctuations in Catformer gas flow are handled with no adjustment of the hydrogen separation plant other than the refrigeration cascade, and this adjustment is mainly automatic.

The nitrogen separation plant is designed so that the idle plant at ambient temperature can be brought on-stream to full, pure nitrogen output in 48 hours. The plant is also designed so that it can be bottled up in the event the air flow is interrupted, and can be restarted cold without deriming after a 6-8 hr. idleness. The plant also can be shut down almost instantaneously and warmed to ambient temperature in less than 24 hours.

Nitrogen separation plant controls are designed so that normal fluctuations in the demand for pure nitrogen by the hydrogen separation or ammonia synthesis plants are handled at the nitrogen separation plant simply by adjustment of the pure nitrogen draw-off valve.

The reversing exchangers are designed to trap and eliminate essentially all the residual water and carbon dioxide contained in the compressed air so that the plant can be operated indefinitely without any type of chemical clean up or predrying of the air, and without interruption of the operation to derime cold equipment.

The silica gel adsorbers are designed to prevent indefinitely acetylene from reaching a dangerous level in the condenser evaporator.

The hydrogen separation plant is designed so that in a period of not more than 72 hrs. its cascade can be charged with refrigerants and the plant cooled to operating temperatures. The plant is also designed so that it can be maintained cold indefinitely using pure nitrogen in place of gas in the event the gas flow is interrupted.

By this means the cold plant can be restarted after an indefinite period of idleness and be producing essentially pure hydrogen in a few hours.

The hydrogen separation plant is also designed so that it can be shut down essentially instantaneously and can be warmed to ambient temperature in less than 24 hours. It will also run indefinitely without deriming.

Acknowledgment

The authors wish to express their thanks to J. D. Peterson and E. M. White of the Atlantic Refining Co. and to E. A. Kelly and M. S. Sze of Hydrocarbon Research, Inc., for assistance in the preparation of this manuscript.

Meet the Authors

Mr. Dixon

Mr. Arnold

William T. Dixon is manager of the design division of the engineering and construction dept. of The Atlantic Refining Co. In this capacity, he represented Atlantic in supervising the engineering design for the catalytic reformer and ammonia plant described in this article. Mr. Dixon started with Atlantic in 1927 and, prior to his present position, served with their research and development department for more than 20 years. Mr. Dixon is a graduate of Princeton University, and obtained his M.S. in Chemical Engineering at the Massachusetts Institute of Technology. He is national director of The American Institute of Chemical Engineers.

John H. Arnold, consulting chemical engineer, was vice-president in charge of engineering of Hydrocarbon Research, Inc., when the Atlantic ammonia plant was designed. Mr. Arnold began refinery engineering work in 1932 after receiving an M.S. in Chemical Engineering from Massachusetts Institute of Technology. His first job was as group leader in research and development for The M. W. Kellogg Co. During World War II Mr. Arnold was director of research and development for the Kellex Corp., with a staff of 300. His duties included direction of the design of special equipment for the Oak Ridge gaseous diffusion plant, preparation of operating manuals, and preliminary equipment testing.

How's Your Fuel Oil Quality?

Basic causes of sludge and gel formation and what processors can do about them

By J. P. KIRCHNER, D. P. OSTERHOUT, and W. R. SCHWINDEMAN
Research & Development Dept., Socony Mobil Oil Co.

TWO major problems—sludge and gel — confronting distillate fuel quality improvement in recent years have now been remedied to a large extent. A variety of both refining techniques and additive materials has proved to be the answer.

What are the basic causes of these problems? And what solutions have been developed?

The sludge problem, caused by unstable fuels, has been remedied by the use of anti-screen-clogging additives which allow the sludge to pass through fuel system filters and strainers and be burned. In addition, sediment inhibitors and refining procedures have improved fuel storage stability.

The copper mercaptide gel problem, caused by the reaction of mercaptans in the fuel with copper in the brass parts of the fuel system, has also been eliminated. Refining techniques remove the mercaptans effectively or convert them into harmless compounds. One additive mixture has also been found which shows promise as a remedy.

Both problems can be solved in many cases by the same refining process. In any case, a proper combination of additives and treating will eliminate the two problems.

Fuel Oil Sludge

Distillate fuel stability has dropped in the past 10 years because the increased demand for more and better product along with more and better gasoline has brought about changes in refining operations. These changes have involved greater cracking severity and the cracking of higher boiling fractions. Both steps have boosted the sulfur and nitrogen content in the distillate fuel stocks. This in turn has had an adverse effect on storage stability.

Because of this greater instability, distillate fuels often form substantial amounts of fuel-insoluble, organic sediment during storage. This sediment mixes with the fuel, dirt and water present in the distribution system and forms sludge. This sludge plugs filters and screens in the consumer equipment and prevents the flow of fuel.

It should be emphasized that except in rare instances fuel system filter stoppage is due primarily to fuel oil sludge and not to the organic sediment in itself.

Sediment is the key to the trouble, since it stabilizes the sludge and acts as the binder which holds the balance of the ingredients in a mayonnaise-like emulsion of oil in water. This sludge is formed in storage tanks where the ingredients are mixed by the agitation which occurs during filling. The sludge is a stable emulsion in contact with either fuel or water. Unless disturbed, it is found floating at the interface between the water and fuel in the tank.

Composition of a typical sludge is:

Water, wt. %	50
Fuel	40
Rust and Dirt	8
Organic Sediment	2

Since the sediment accounts for only 2% of the weight of the sludge, it is obvious that a large amount of sludge can form from a relatively small amount of organic sediment.

This has been demonstrated in one test on the amount of dry sediment forming in field storage on the eastern seaboard with increasing time. An unstable fuel formed 40 mg/l of sediment after 4 months of storage. This much dry sediment precipitated from the 1700 bbl. of fuel in the tank could form more than 1000 lb. of sludge under the proper conditions.

It is difficult to determine how much sludge can be tolerated in a fuel distribution system before trouble hits. Furthermore, the sludge floats at the interface. Therefore, it is stirred up and delivered with the fuel in a random fashion. Outbreaks of sludge trouble are often sporadic.

Several precautions can be taken, however, to minimize these problems:

1—Eliminating tank water bottoms will help, although it will not solve the problem completely. Some water will still be present due to the precipitation of dissolved water from the fuel itself, and condensation from the tank atmosphere.

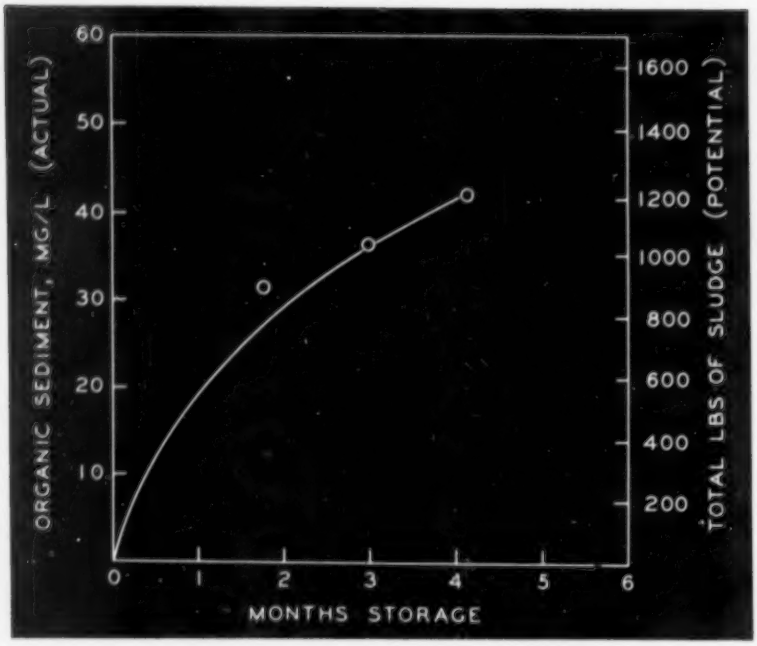
2—Allowing the fuel to settle after the tank is filled may also help. Sediment and sludge will remain in the tank after settling.

3—Other helpful measures include: annual tank cleaning, inspection of the system to detect sludge, and installation of filters at loading racks and major storage terminals.

Trouble will still occur in spite of all this effort because sludge will eventually form right in the customer's fuel tank. More thorough measures are needed for a permanent solution.

Mercaptide Gel

An entirely different problem is the formation of gel-like deposits due to



POTENTIAL SLUDGE IS HIGH even when actual organic sediment is low. These are results in 1700-bbl tank test on No. 2 fuel oil

Worst Gel Formers are the Mercaptans in Cracked Fuel

Table 1—Effect of Mercaptan Type on Gel Formation

Stock	Wt.-% Mercap. Sulfur	mg. S as Mercap. recovered from test filter
Catalytically cracked distillate	0.0233	1400
Straightrun distillate	0.0258	154
Catalytically cracked distillate	0.0264	750
Straightrun distillate	0.0261	100

the action of mercaptans in the fuel with the copper in *brass* parts of the fuel system.

This has come about largely as the result of processing higher sulfur crudes and greater severity in cracking, which produces larger amounts of mercaptan sulfur compounds boiling in the distillate fuel range. Field troubles are quite baffling on first contact because gel does not resemble any of the ordinary troubles in oil burners or diesel engines.

The deposits resemble small lumps of lemon or amber colored jelly adhering to brass parts and clogging the interior of brass nozzle filters.

This gel is not soluble in any conventional solvent and thus presents a severe service problem; it can only be removed from the burner and fuel system by tearing down the unit and hand cleaning. If this is not done, call backs occur, for small pieces of gel migrate through the system from uncleaned areas, plug the nozzle or other sensitive points and again shut down the unit.

Mixtures of Straightrun and Catalytic Mercaptans Form the Most Gel

Table 2—Effect of Blends on Gel Formation

Cat cracked distillate	S.R. Dist.	Blend* Calcul.	Blend* Actual
750**	150	510	1050
550	200	410	950
800	108	520	1000
225	175	205	575
150	150	150	750

* Cat. cracked dist., 60 vol.-%; SR., 40 vol.-%.

** Quantities are in mg. of culfur as mercaptan formed on the test filter.

Analyses of these deposits showed that they are essentially a grease composed of fuel oil with small amounts of copper mercaptides as the soap or gelling agent. Traces of water and oxygenated material were also present. As noted later, water is necessary to the formation of these deposits.

A detailed analysis of a gel deposit is:

Fuel, wt.-%	95.0
Copper mercaptide, wt.-%	1.8
Oxygenated compounds, wt.-%	2.2
Water, wt.-%	1.0
Empirical Formulae	
Copper mercaptide	$C_{12}H_{25}—S—Cu$
Oxygenated compounds	$C_{20}H_{37}COOH$

A laboratory test has been developed to simulate field operation. In this test, gel is produced from No. 2 fuel by circulating it through a brass filter for a period of two weeks. At the end of that time the test filter is analyzed for the weight of copper mercaptide present. This is done by converting the copper mercaptide formed on the filter to mercaptan with acid and titrating the mercaptan.

The result of the test is reported as micrograms of sulfur as mercaptan present on the filter. Extremely precise micro techniques were evolved to make this measurement, which is accurate to plus or minus 3 micrograms (0.000003 grams).

Although it is not possible to rate the filters by visual means, a gel deposit may easily be seen under low power magnification. This test has demonstrated that mercaptans are the causative agent in gel formation, and that the amount of gel is directly related to the amount of mercaptan in the fuel.

The following significant points were developed:

1—All mercaptans found in No. 2 fuel form copper mercaptide (and gel) under the proper conditions. From samples of both straightrun naphtha and gas oil, the sulfur as mercaptan recovered from the test filter was 200 mg. From sour straightrun No. 2 fuel oil, it was 300 mg.; and from catalytically cracked No. 2, it was 800 mg.

2—Disulfides do not form gel at normal operating temperatures.

3—Weight for weight, the mercaptans in cracked fuel are by far the worst offenders. See Table 1.

4—The greatest quantities of gel are formed from mixtures of catalytic and straightrun mercaptans. In other words, mixtures of straightrun and catalytic fuel form more gel than would be expected from the gel-forming tendency of the components. Table 2 demonstrates this. All blends gave gel numbers at least twice as

high as calculated from the numbers of the individual stocks.

This effect can also be produced by adding thiocresol type mercaptans to straightrun fuel.

Water must also be present to achieve the maximum amount of gel formation, aside from the presence of mercaptans of the proper types. Laboratory studies of conditions affecting gel formation show that distilled water, salt water, and caustic are increasingly harmful. See Table 3.

The mechanism involved here is probably a corrosive attack of the brass to release copper ions. Also, the gel itself is stabilized by the trace amount of water found in it.

A field test has shown there is correlation in the rate of gel formation of various fuels in full scale equipment with the results of the laboratory gel test.

One fundamental question not yet settled is whether copper mercaptide gel forms exclusively on brass or whether it will form on copper.

The authors' field experience has supported the stand that it *forms* exclusively on brass surfaces, or on the copper at a junction of copper with galvanized (zinc) pipe. It may, of course, be found on an iron screen where it has been caught after being dislodged from a brass portion of the system upstream of the filter.

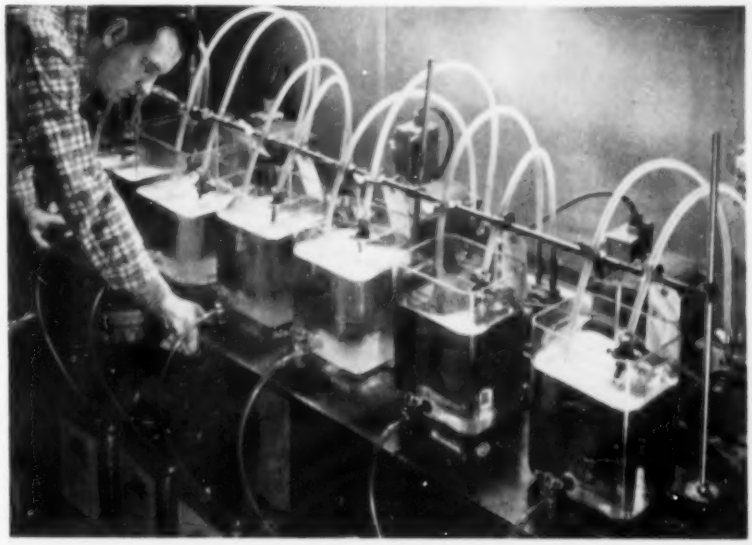
Careful inspection of copper lines and parts has never revealed either gel or evidence of a corrosive attack on the copper such as is normally observed on brass which has had gel on it.

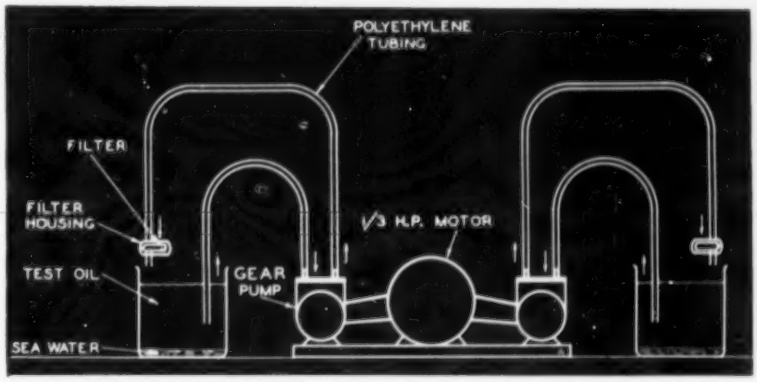
One possible explanation for this is that copper usually tarnishes quite readily (relative to brass) and this might make it less subject to attack by mercaptans.

On the other hand, informally received reports from others who have observed this phenomenon indicate that in their opinion gel forms quite readily in copper fuel lines. In an effort to check this report, special copper filters were run in the laboratory gel test in comparison with the standard brass filter. Only a small amount of gel was found on the copper. These data are given in Table 4.

The best approach to this problem is to remove the offending mercaptans from the fuel by additional refining. Any treating method used should remove as much of the mercaptan as possible since gel formation continues even at low mercaptan levels.

Although a mixture of two distillate fuel additives has been developed which reduces gel-forming tendencies, it appears that refining to eliminate mercaptans may be the best approach because it makes other contributions to product quality.





TEST FOR MERCAPTIDE GEL in fuel oil was made in this multiple unit laboratory apparatus. Drawing shows schematic for single unit

Water Also Boosts Gel Formation

Table 3—Effect of Free Water Type on Gel Formation

Water	pH	mg S as Mercap.
Distilled	7	270; 220
Synthetic sea	8	620; 590
Dist. + 1% NaOH	11	1600; 1300
Dist. + 1% HCl	1	200; 200
Dist. + 1% NaCl	7	400; 300

More Gel Forms on Brass than on Copper

Table 4—Comparison of Brass and Copper Test Filters

Sample	Type Filter	mg S as Mercap.
1	Brass	200; 180
1	Copper	80; 70
2	Brass	100; 90
2	Copper	20; 15
3	Brass	400
3	Copper	100

Solutions to the Problems

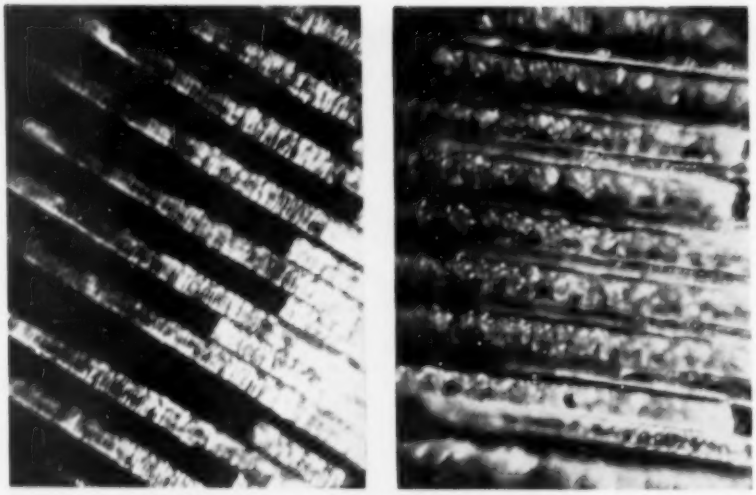
The actual selection of a specific remedy to both the storage stability and the mercaptide gel problems will vary with each individual refiner. There are several types of additives and refining techniques, all with varying effectiveness. In some instances, the same remedy will solve both problems.

How effective are these remedies? The next section will discuss this.

Additives

Two types of additives may be used to remedy the sludge problem.

The first is commonly known as a



HOW GEL DEPOSITS ON BRASS—photomicrographs (60X) of test filters before and after test in apparatus shown on p. 69

dispersant, or more accurately, an *anti-screen clogging agent*. This type does not prevent the formation of sludge, but does enable it to pass through strainers and filters and be burned without causing any difficulties.

It should be pointed out that anti-screen clogging properties can be imparted to fuels only by additives. It has been the authors' experience that a fuel containing an anti-screen clogging agent may produce two to three times as much sludge as one which contains no additive and still provide trouble-free performance.

The second type of additive is known as a *sediment inhibitor*. In many instances the fuel is so unstable that an uneconomical dose of an anti-screen clogging additive would be required to cope with all the sludge that forms, and a sediment inhibitor should be added to the fuel to improve its storage stability. Such an additive acts to eliminate or reduce the formation of the insoluble sediment which causes sludge.

The usefulness of a sediment inhibitor alone is somewhat limited, however, for once a fuel system becomes contaminated with sludge, difficulties will persist in spite of the fact that the stability of the fuel may be improved. Thus it is necessary in most cases to add an anti-screen clogging agent to disperse the sludge which is already present in the system. Some additives are available that perform both functions.

Caution must be exercised in selecting additives for solving the sludge problem. It is a relatively simple matter to discover a compound which imparts either satisfactory storage stability or anti-screen clogging properties to No. 2 fuel oil. However, it is considerably more difficult to provide these properties without also adding unwanted and troublesome properties to the fuel.

Additives can have undesirable effects on the following: carbon residue, ash, emulsion-forming tendencies, water haze retention, water extraction and hydrolysis, and corrosion.

Although sediment inhibitors and anti-screen clogging additives do not generally affect the gross process of combustion, they *may* lay down a deposit which interferes with equipment operation.

For example: any additive which forms either ash or carbonaceous deposits will affect operation of rotary vaporizing and pot type oil burners and diesel injector nozzles. In the rotary burner, they short the starting electrodes of the ignition system: in diesels the nozzle spray pattern is distorted.

Emulsion and water haze problems occur with some anti-screen clogging additives. This is not unexpected; compounds that disperse sludge might also be expected to disperse water. Some additives promote the formation of a water-in-oil emulsion that plugs strainers and filters as quickly as sludge. In advanced stages, these emulsions do not settle out of the fuel for long periods of time. Water haze causes difficulty with paper and fabric type filters which can be wetted with water.

Water extraction and hydrolysis are additive rather than fuel properties. Some additives are extracted easily or hydrolyzed by water; therefore they do not remain in the fuel to perform their intended function.

Additives should not corrode the metals commonly found in fuel systems—iron, zinc, copper, brass, and white metal.

A number of laboratory tests, developed to show the advantages and disadvantages of additives, have been described in greater detail in the literature.[5] They include: 1) sediment inhibition, 2) anti-screen clogging, 3) emulsions and water haze, and 4) water extraction and hydrolysis. The remaining tests consist of running the more standard physical, chemical, and performance tests for distillate fuel.

A comparison of advantages and disadvantages of a number of commercially available distillate fuel oil additives is shown in Table 5. It will be noted that all those listed show sediment inhibiting and/or anti-screen clogging properties. Yet, only the first three in the list are free from disadvantages.

In addition to the evaluation of additives to perform as oxidation inhibitors and anti-screen clogging agents, development work was also conducted on additives which might be useful in controlling gel formation.

One theory was that a chelating material which would combine with the copper ions entering the fuel might reduce their ability to react with the mercaptans to form gel. This worked to some degree in laboratory tests on fuels from a particular crude source. However, it proved to be ineffective in fuels from other crudes. Field tests with one fuel showed that this type of compound had substantially no effect on gel formation.

Many other commercially available and experimental additives have been tested to study their effect on the formation of gel. To date only one material has shown evidence of being effective over a wide range of circumstances. This material is a mixture of two distillate fuel additives which show a marked synergistic effect in eliminating gel formation.

Refining

In extreme cases the storage stability of No. 2 fuel oil may be so poor that additional refining is required to eliminate or reduce the formation of the sediment that causes sludge. In most cases refining is more expensive than additives; however, there is a point where the use of additive alone in extremely unstable fuels is too

costly. At this point it becomes economically feasible to refine the fuel to improve its storage stability.

However, there is no treating process that imparts anti-screen clogging properties to the fuel and it is usually necessary to add an anti-screen clogging additive to prevent trouble from sludge already present in the system.

Refining may also be used to good advantage in combination with sediment inhibitors. In some fuels, it alone will not appreciably reduce sediment formation; however, when the treated fuel is inhibited, satisfactory sediment stability is achieved.

Refining is also the best remedy known for the mercaptide gel problem. Most of the treating processes found to be effective in improving storage stability of cracked stocks also extract mercaptan sulfur compounds. Thus, in many cases both the sludge problem and the gel problem can be eliminated by the same refining process.

Table 6 shows the effect of several of the more well-known treating processes on the sediment and gel forming tendencies of cracked and straightrun fuels and blends of these fuels.

The first two processes in Table 6, *mild and strong caustic*[1] *extraction*, remove acidic compounds from the fuel, including the gel forming mercaptans from cracked fuel. Also, the acidic compounds which are removed are partly responsible for poor storage stability.

These processes often provide fuels with greatly improved sediment inhibitor susceptibility. Caustic extraction will not, however, remove the basic nitrogen compounds which also have an adverse effect on stability. Neither will it remove the mercaptans from straightrun fuels.

A *sweetening process*, such as doctor or copper chloride treating, will convert mercaptans in light distillate straightrun stocks to harmless disulfides. These processes do not improve stability of these stocks. However, this is relatively unimportant inasmuch as straightruns are usually quite stable.

Acid treating may be applied to fuel oils to remove basic nitrogen compounds from the fuel which harm stability. When followed by a caustic washing step to remove the acidic compounds, both the gel problem and sediment problem can be eliminated. However, this process is costly and poses the additional problem of acid sludge disposal.

Furfural extraction removes mercaptans, polar compounds and aromatic materials, providing fuels with excellent storage stability and low mercaptan content. This is a costly process, however, because of the high yield losses.

Hydrogenation provides fuels of excellent storage stability and essentially free of mercaptans. This process is of great interest currently, since the necessary hydrogen is becoming available due to the installation of catalytic reforming units for gasoline.

There are several other processes available which will improve the quality of No. 2 fuel oil, including *SO_2 extraction* and *vapor phase desulfurization*. The former is a relatively expensive process but provides good stability and relatively low mercaptan content. The latter is quite effective in removing mercaptans but does not always improve fuel stability.

Only Three Additives Showed No Disadvantages at All

Table 5—Evaluation of Commercial No. 2 Fuel Oil Additives

	Advantages			Disadvantages			
Additive	Sedi. inhib. normal Temp.	Color inhib. normal Temp.	Anti-screen clog.	Ash Form	Increase Carbon Resid	Promotes Emulsion	Promotes Water haze
A	Yes	No	Yes	No	No	No	No
B	Yes	No	No	No	No	No	No
K	Yes	Yes	No	No	No	No	No
D	Some	No	Yes	No	No	Yes	Yes
E	Some	No	Yes	Yes	Yes	Yes	Some
L	No	Some	Some	Yes	Yes	Yes	Yes
G	No	No	Yes	Yes	Yes	Yes	Some
M	No	No	Yes	Yes	Yes	Yes	Some
I	Some	No	Yes	Yes	Yes	Yes	Some

Illustrations

The photographs of equipment shown in this article and this month's cover picture were made by John M. Wingate, Socony Mobil Oil Co., Paulsboro, N. J.

References

(1) "Evaluation of Additives for Distillate Fuels," F. L. Nelson, D. P. Osterhout, and W. R. Schwindeman. American Chemical Society meeting, Fall, 1955, Minneapolis, Minn.

(2) "Dualayer Distillate Fuel Oil Treating Process," C. A. Duval, R. T. Malin, and V. A. Kalichevsky. 19th mid-year meeting, American Petroleum Institute, Division of Refining, May 1954, Houston, Texas.

How Various Refining Techniques Affect Distillate Quality

Table 6—Effect of Treating Processes on Sediment and Gel Formation in No. 2 Fuel Oil

Fuel	Wt.-% Mercaptan Sulfur	mg. sulfur as mercaptan recovered from gel test filter	Stability test* 25 lb/1000 bbl Additive A. No addit.	Additive A.
Catalytically cracked:				
Distillate	0.0180	800	168	110
Mild caustic extraction	0.0010	50	40	12
Strong caustic extraction	0.0003	30	25	15
Acid treated	0.0004	—	7	7
Furfural treated	0.0015	—	9	9
Hydrogenated	0.0003	20	10	10
Straightrun distillate:				
Raw	0.015	100	5	5
Sweetened	0.001	50	—	—
Hydrogenated	0.0001	20	**	—
Blend:				
Raw	0.0170	1100	130	75
Treated**	0.001	50	65	15
Hydrogenated	0.0004	20	8	8

* Storage stability test: 12 weeks at 110° F., sediment in mg/l.

** Cat cracked distillate—mild caustic extraction.
Straightrun distillate—sweetened.

TO AVOID FAILURES LIKE THIS in a standard weight refractory castable in a process vessel lining, you'll find . . .

Comparative Tests Best for . . .

Selecting Refractory Castables

By C. M. VOGRIN and H. HEEP
M. W. Kellogg Co., New York

PROPER selection of a refractory castable means considering factors beyond the maximum service temperature. All possible service conditions must be given consideration, for example:

1—Cycle temperature variations during operation.

2—Expected frequency of shutdowns.

3—The method of cooling.

4—The possibility of runaway temperatures.

For example, in the photograph above, a test sample of a standard weight refractory castable, usually recommended for a maximum service temperature of 3000° F., has failed after four cycles of heating to 1800° F. in an illuminating gas atmosphere.

In some cases, specifications of castables for new uses can only be made after running tests similar to those described below. Before specifying refractory castables for some unusual operating conditions, the authors ran a series of tests to determine the limitations of commercially available material.

Some specific guides resulted from these tests:

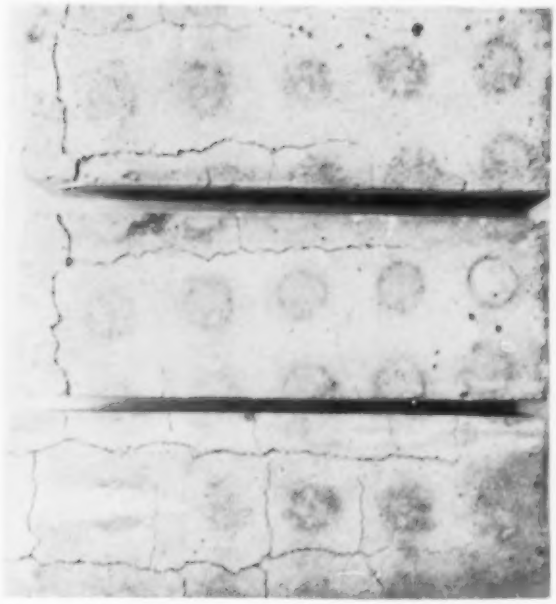
- The maximum service temperature, as recommended by reputable manufacturers, is reliable. Material with ratings up to 2000° F. will not fail, even if soaked at the maximum temperature. However, ratings from 2250-3000° F. must be considered as hot-face temperatures.
- Castables containing high early strength portland cement as hydraulic binder can be used without limitations up to 1300° F. At higher temperatures some instability exists during subsequent cooling and shut-down periods. However, portland cement mixes offer good resistance against carbon disintegration.
- Castables containing Lumnite (calcium aluminate) cement possess temperature stability up to 2250° F. when combined with suitable aggregate. Service atmospheres containing high percentages of CO and CH_4 will cause carbon disintegration in a range of 900-1700° F.
- Castables for hot-face temperatures of 2500-3200° F. require iron-free calcium aluminate cement for stability. And if mixed with equivalent inert aggregate they will provide the greatest stability against various service environments.

The first use of refractories dates back in history to 3,000 B.C., when sun-dried bricks were used in the first Egyptian pyramid. It took 2500 more years until burned silica brick, the ancestor of modern refractories, was produced in Chaldea. Although "firebrick" is still used extensively today, a relative newcomer, castable refractories, is used widely in the petroleum industry for catalytic cracking units.

A refractory, by definition, is any material that can be heated slowly to 2732° F. (1500° C.) without showing any signs of fusion.

A castable refractory is one with a hydraulic binder, suitable for casting into heat-resisting shapes or walls.

The World War II demand for catalytic cracking units with their special shapes, high temperatures, and erosion



IMPROPER ARTIFICIAL DRYING of these lightweight castables resulted in cracks. The maximum drying temperature of 500° F. was attained faster than specified, and internal steam pressure caused the damage

INSTABILITY OF HYDRATED COMPOUNDS in the calcium cement caused this. The specimens show no defects after firing once at 1750° F. in illuminating gas, yet the above resulted six months later

problems accelerated the use of castable refractories. The catalyst regenerator sections, as well as the catalyst transfer systems, risers, and duct lines, lent themselves easily to monolithic applications of refractories.

In 1946, the authors' company had successfully installed a castable lining in a regenerator of a Fluid catalytic cracking unit. But a search of literature, years later, did not contribute sufficient information to justify the same type of lining for temperatures up to 2400° F., especially in a reducing atmosphere of CO, H_2, CO_2, CH_4, and H_2O.

In order to judge the information available in manufacturer's catalogs, which did not always furnish the basis of their recommendations, a series of tests was run. The results of these tests on commercially available products are summarized in this article.

What Materials Were Tested?

The commercial products selected could all be handled like ordinary concrete and would develop a hydraulic bond. When exposed to elevated temperatures, they developed a ceramic bond. Two methods of classifying the materials were used: by service, or by hydraulic binder:

On basis of the service conditions the groupings were:

Standard weight castables, with densities of 100-300 lb./cu.ft., and qualities comparable to firebrick.

Insulating castable (medium weight), with densities of 70-100 lb./cu.ft. These were designed for single liner applications, and were a compromise between insulating qualities, structural strength, and erosion resistance.

Insulating castables (light weight), with densities of 30-50 lb./cu.ft., in which strength was sacrificed in favor of low conductivity.

Erosion resistant castables.

By hydraulic binder, the groupings were:

Portland cement—of the high early strength type.

Aluminous cement—of the ordinary type, which had an analysis of: Al_2O_3, 36—39%; CaO, 37—39%; SiO_2, 5—5½%; Fe_2O_3, 11—13%; FeO, 4—5%; TiO_2, and 1½—2%.

High purity aluminous cement—a

How the Refractory Tests Were Run

TEST specimens were cast blocks measuring 2x2x6 in., and were made from a wet mix ratio specified in ASTM C91-40. Flow of 75% provided sufficient workability to cast uniform specimens without drawing water to the surface. The determination of initial and final set followed the Gilmore needle method, in accordance with ASTM A191.

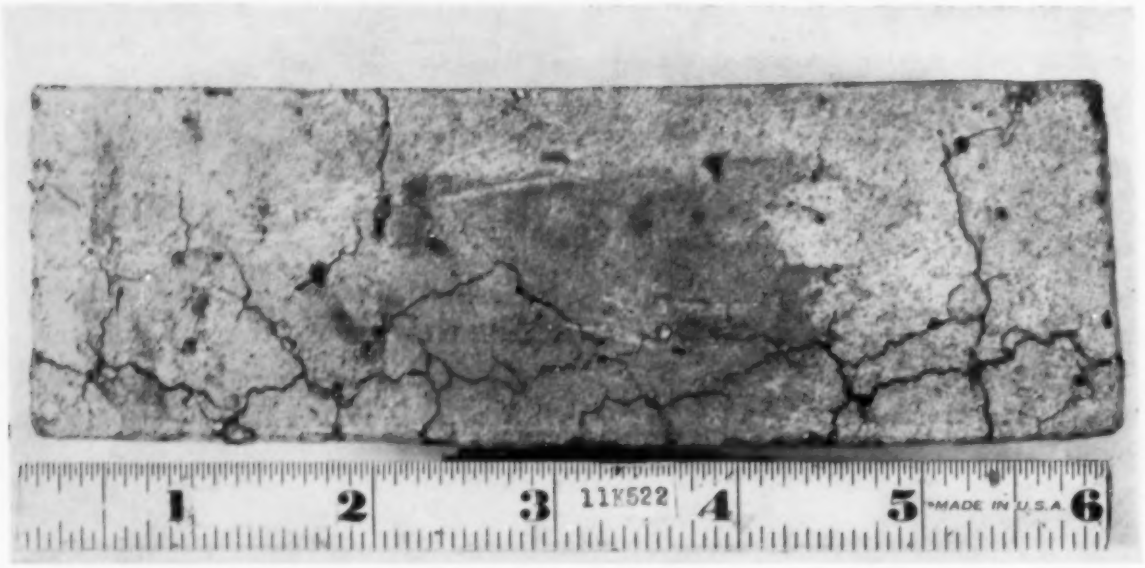
The test program consisted of two procedures:

Progressive Heat Soaking—each specimen heated from ambient to test temperature as quickly as special furnace allowed. After soaking at test temperature for remainder of eight hours, the specimens were cooled overnight and removed from the furnace.

Cyclic Heat Soaking—each specimen subjected to a cycle of above tests, one day for either 10 or 5 days.

Both tests were carried out in oxidizing atmospheres (up to 1800 and 2300° F.) and in reducing atmospheres (up to 1200, 1800, and 2400° F.).

Chemical analysis of unfired and fired specimens were made to determine relations between carbon depositions and iron content of the castable.



FAILURE FROM CARBON DISINTEGRATION in this medium-weight castable resulted after three heating cycles at 1800° F. in an illuminating gas atmosphere

special calcium aluminate binder featuring a reduced iron content of 1% or less, combined with a corresponding higher percentage of alumina (Al_2O_3).

What the Tests Showed

The results of the tests showed that the information circulated by reputable manufacturers is fairly correct, but that it is incomplete—especially when castables must be specified for new service conditions. Our tests and a review of all available information led us to these conclusions:

Standard Weight Castables. (Recommended by manufacturers for a maximum service of 3000° F.).

During heat soaking, plastic deformation set in at 2400-2500° F. Softening gradually increased until fusion occurred slightly beyond the maximum recommended service temperature. Consequently, temperatures above 2400° F. must be strictly limited to hot face temperatures if there is any appreciable load to be supported.

In general, materials of this group displayed stability during all tests under both oxidizing and reducing conditions for all soaking temperatures up to 2400-2500° F. Out of four materials tested, one castable was selected for liners of combustion chambers operating from 1700 to 2300° F., and has given satisfactory service over an operating period of about two years.

Insulating castables—medium weight. (Recommended for maximum service of 2250°F.).

During soaking at the maximum recommended service temperature some softening was observed. However, when cycled at 1800° F. in illuminating gas all materials of this group disintegrated or cracked considerably, *but* were stable during the same test in oxidizing atmosphere. Cracked specimens pressed between fingers crumbled into fine powder of black and rusty-red color and generally unharmed pieces of aggregate.

No other test produced failures of this type, which evidently were caused by carbon depositions inside of castables containing more than 1¼% of iron. The temperature of 1800° F. for this type of failure was surprising because the familiar case of carbon disintegration is more likely to occur at lower temperatures. (The tentative ASTM Carbon Disintegration Test calls for temperatures of only 900-950° F.).

Insulating castables—light weight. (Recommendations by the manufacturers ranged from 1800-2000° F.).

No castable of this group was found unconditionally stable above 1300° F. In the range between 1500-1800° F., specimens cracked or crumbled, particularly during cycling. Those recommended for up to 2000° F. were stable at that temperature. At 2250° F. all of them fused completely into a black or green glossy mass.

Permanent shrinkage after exposure to temperatures above 1300° F. was high. In some cases a shrinkage of 5% was measured for 1500-1700° F. This compared with only 0.2-0.3% for castables of standard weight under the same conditions.

Some specimens also cracked several months later after exposure to temperatures between 1500-1800° F. Special care was necessary during artificial drying. Because of their porous nature, light-weight castables retain more moisture, which results in destructive steam pressure if temperatures are raised too fast.

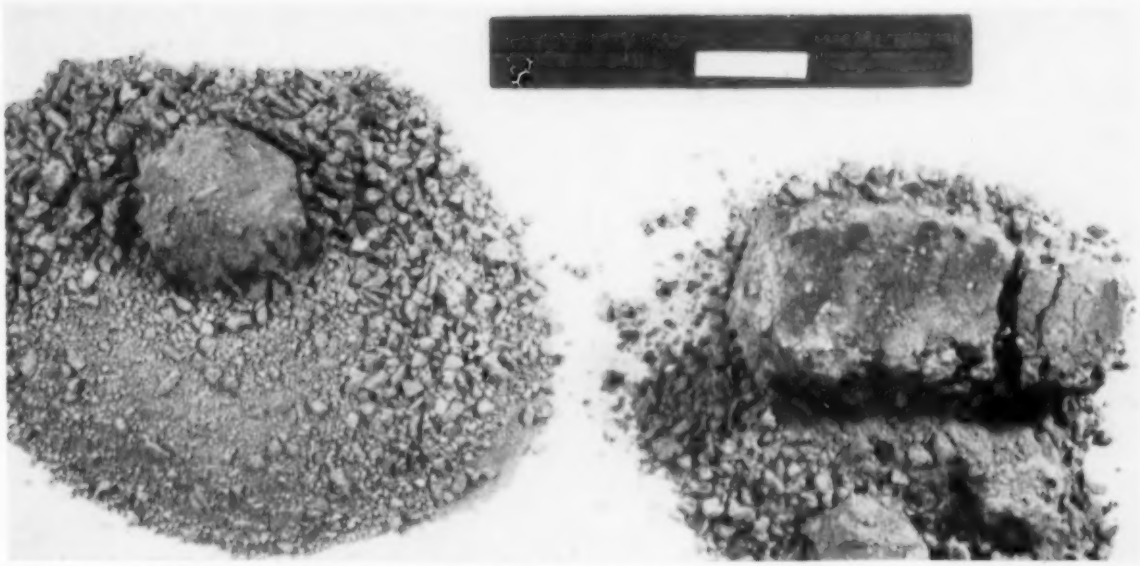
Erosion resistant castables. (Recommended by manufacturers for erosion up to 1200° F.).

The materials tested behaved as could be expected from their binders of calcium aluminate or high early strength calcium silicate. The ones containing calcium silicate cement fused at 2250° F. and, with one exception, also displayed instability in the 1500-1800° F. range.

Since correlations exist between erosion rate and compressive strength, the cement:aggregate ratio is on the cement-rich side to provide maximum strength. And, at elevated temperatures, a cement-rich ratio is detrimental because the hydraulic bond decreases because of dehydration. In all cases the coarse aggregate was either crushed fire brick, silicon carbide, or corhart.

Is the Binder Important?

These results show that the cementitious binder is the decisive factor in the stability of refractory castables.



UNSTABLE HYDRATED COMPOUNDS caused failure in this erosion resistant castable. Sample at left was fired at 1750° F.; one on right at 2000° F., both in oxidizing atmosphere. No defects on leaving furnace. Cracks developed afterwards

Aggregates generally possess superior stability because they are either prefired to incipient fusion or stabilized in some other way. It is the binder which undergoes drastic changes with temperature and exposure to atmosphere.

All specimens with calcium silicate cement mixes revealed a general tendency to fail after heating at temperatures of 1500-1750° F. These failures included all intermediate steps from fine deep cracks to complete disintegration. And they became noticeable from several days to five months after removal from the furnace. (In reheating tests, the failures occurred in the furnace.) This instability was observed in oxidizing as well as reducing atmospheres; it was more pronounced with light-weight aggregate than with heavier aggregates.

All castables containing calcium silicate cements failed completely, with one exception, when vitrification set in between 2000 and 2250° F. Their sudden and complete failure—within a 100° F. margin above recommended maximum temperature—was significant compared with the aluminous cement castables. All these failed *gradually* when overheated with a progressive softening spread over a range of several hundred degrees. Thus the aluminous cement castables provide a much greater margin of safety against runaway temperatures.

Specimens bonded with regular calcium *aluminate* cement failed consistently when cycled at 1800° F. in illuminating gas atmosphere. This disintegration was obviously caused by destructive internal carbon depositions, around nuclei of iron particles, which produced disruptive forces. Unfortunately the rupture strength of castables is at a minimum around 1800° F., since the original hydraulic bond is lost by dehydration and the temperature is still too low to form an effective ceramic bond.

However, when calcium silicate cement was used, these disruptive carbon depositions were not noticed. This may be explained by the lower iron content and the addition of sulfur compounds. Although the sulfur compounds are added to aid quick setting, their effectiveness as a catalyst poison may have been responsible.

Only iron free *alumina* castables proved to be stable over the whole temperature range, in oxidizing as well as reducing atmospheres.

Meet the Authors

MR. VOGRIN

MR. HEEP

Christian M. Vogrin is a section engineer in the piping division of the M.W. Kellogg Co., with whom he has been associated since 1942. He is a graduate of City College of New York. His activities in the Society of Automotive Engineers include membership on three different subcommittees dealing with fabrication, steel flanges, and pipe flanges and fittings.

Heinrich Heep is also associated with the M.W. Kellogg Co. Before joining Kellogg in 1952, Mr. Heep was employed as a consultant on submarine propulsion problems by Vickers Armstrong in England and by the U.S. Navy. During the war he headed the submarine development division of H. Walter, A.G. in Kiel, Germany, making contributions to the design of the "Snorkel." He has an M.S. degree from the Technical University of Berlin.

2-Inch Single-Ported Control-Valve Characteristic Curves, 4-in. line,

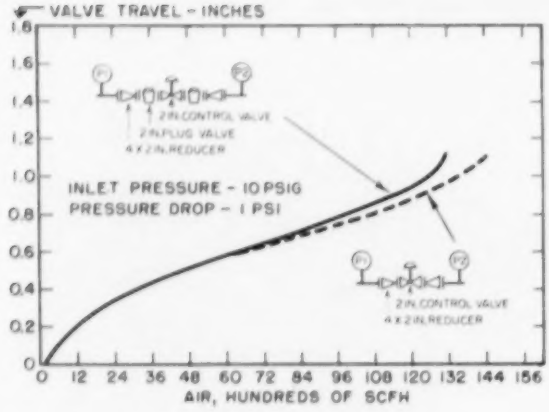

VALVE TRAVEL - INCHES
2 IN. CONTROL VALVE
2 IN. PLUG VALVE
4 X 2 IN. REDUCER
INLET PRESSURE - 10 PSIG
PRESSURE DROP - 1 PSI
2 IN. CONTROL VALVE
4 X 2 IN. REDUCER
AIR, HUNDREDS OF SCFH

FIG. 1—Low pressure drop

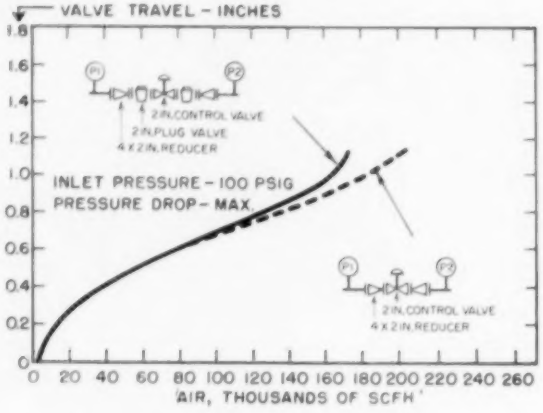

VALVE TRAVEL - INCHES
2 IN. CONTROL VALVE
2 IN. PLUG VALVE
4 X 2 IN. REDUCER
INLET PRESSURE - 100 PSIG
PRESSURE DROP - MAX.
2 IN. CONTROL VALVE
4 X 2 IN. REDUCER
AIR, THOUSANDS OF SCFH

FIG. 2—Critical pressure drop

How to design manifolds for . . .

Good Control Valve Operation

CONTROL valves will not work properly if nearby piping arrangements are wrong. Often the care used to select a control valve is partially offset by poor installation practices, and failure to allow for pressure drops through the valves and adjacent piping.

Therefore, those who select the valves should also review the actual installation details. To help this review, the following presents test data and conclusions for several common plug cock, control valve-manifold arrangements. When ill effects result from the arrangement, they are discussed.

Results of these valve-manifold tests showed:

- Valve characteristic changes for various piping arrangements cannot be predicted.
- Arrangements giving a nozzle effect into a single-seated valve body harm valve characteristics.
- Reductions from line size of inlet block valves affect capacity and characteristic—thus a valve cost saving requires more pumping horsepower for same flow rate.
- Place the valve in a straight-through section of a block and by-pass arrangement. Tortuous manifolds designed for accessibility can harm valve characteristics and capacity.
- In gas service, the fact that critical pressure drop is available does not insure that manifold pressure loss will not affect valve capacity.

For valve types other than the plug cocks used on these tests, results will depend on the flow pattern and pressure loss characteristics through them.

Note that care must be used to apply these results to other installation types, especially those with high pressure drops, viscous flow and two-phase flow. Control valves sometimes have large discontinuities in characteristics which can be magnified by a poor piping arrangement around the control valve.

In the following test results the control valve basic capacity is plotted for reference. This capacity is measured by taking the pressure drop across the valve plus the pressure drop from the two necessary inlet and outlet flange reducers on the control valve.

It is also common practice to include drop across the entire control-valve manifold under the pressure differential available for control (if 10 psi drop is allowed for control, 2 psi of this may be used in the piping immediately adjacent to the control valve).

In the following results, the control valve and its adjacent piping are considered a system and treated as a unit in assigning pressure drop and calculating flow. While it seems obvious that a reduction in effective control valve capacity will result, it does not insure that its effects will be compensated for. Oversizing of many control valves by duplication of safety factors prevents this effect from being commonly noticed. All control valves for these tests are the flanged globe type.

STRAIGHT MANIFOLDS

4-Inch Lines

The initial tests compare control valve capacity and characteristic with and without plug cocks used as block valves. The basic unit is a 2-in. single-ported control valve (with a throttle plug inner valve) in a 4-in. line. When 2-in. plug cocks are added, the 4-x-2-in. concentric reducers are on the out-

with and without 2-in. plug cocks

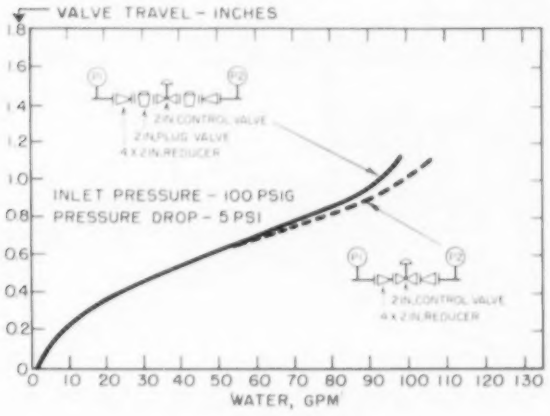

VALVE TRAVEL - INCHES
INLET PRESSURE - 100 PSIG
PRESSURE DROP - 5 PSI
2 IN. CONTROL VALVE
2 IN. PLUG VALVE
4 X 2 IN. REDUCER
WATER, GPM

FIG. 3—Water flow

side of the plug cocks (away from the control valve). However, when 4-in. plug cocks are used as block valves, the reducers are on the control valve inlet and outlet flanges.

All pressure drops are measured for the total manifold unit—control valve, plug cocks, and reducers.

2-Inch Plug Cocks

Low pressure drop. Plug cocks reduce control valve capacity about 8.5% for tests with 10 psig inlet air and a one psi system pressure drop, shown in Fig. 1.

Critical pressure drop. Increases in upstream pressure (to 100 psig inlet air) and pressure drop (to maximum) reduce control valve capacity by 13.5%, shown in Fig. 2, when plug cocks are added.

Intermediate pressure drops. Tests with air between 10 and 100 psig show a continuous capacity drop as upstream pressure and pressure drop increase and plug cocks are in the line. A double-ported valve in place of the single-ported control valve gives nearly the same results.

Water flow. Using 100 psig inlet water and a 5 psi pressure drop, maximum capacity falls about 9% when the plug cocks are added, shown in Fig. 3. Tests at other pressures and pressure drops (with both single- and double-ported control valves) give similar results.

4-Inch Plug Cocks

Low pressure. For the test with 10 psig inlet air and one psi pressure drop, manifolding has little effect on valve capacity or characteristics when 4-in. plug cocks are substituted for the 2-in. ones, and the reducers correspondingly relocated, shown in Fig. 4.

Critical pressure drop. Tests on a single-ported control valve with 75 psig inlet air and maximum pressure drop give only a slight loss of capacity —shown in Fig. 5—but the valve characteristic changes in the last 40% of the stroke (possibly due to the flow pattern made by the piping in the single-ported valve body). Double-ported valves show no such results under the same conditions.

Water flow. Generally for liquid flow, there is little change in valve characteristic or capacity when using line-sized plug cocks in the manifold. For low pressure drops, double-ported valves lose 4-5% in maximum capacity, but the effect is negligible when the pressure drop is raised to 5 psi.

STRAIGHT MANIFOLDS

8-Inch Lines

Comparisons to the preceding tests were made using an 8-in. line, a single-ported 4-in. control valve, 4-in. plug cocks for block valves, and 8-x-4-in. concentric reducers. Results are simi-

2-Inch Single-Ported Control-Valve Characteristic Curves, 4-in. line, with and without 4-in. plug cocks

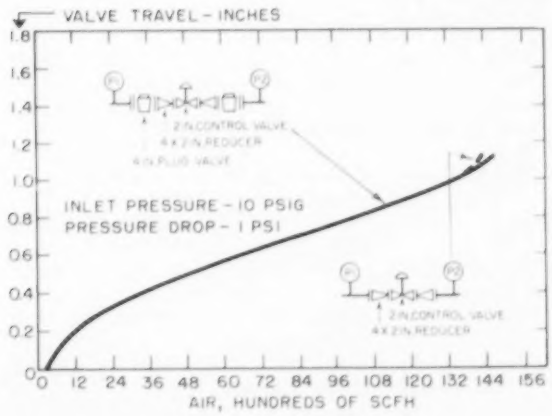


FIG. 4—Low pressure drop

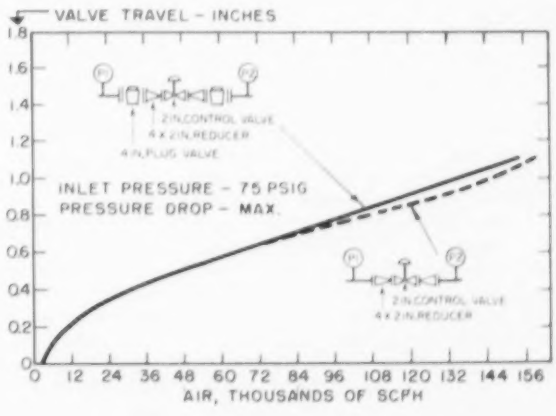

VALVE TRAVEL - INCHES
INLET PRESSURE - 75 PSIG
PRESSURE DROP - MAX.
2 IN. CONTROL VALVE
4 X 2 IN. REDUCER
4 IN. PLUG VALVE
AIR, THOUSANDS OF SCFH

FIG. 5—Critical pressure drop

4-Inch Control-Valve Characteristic Curves, 8-in. line, with and without 4-in. plug cocks

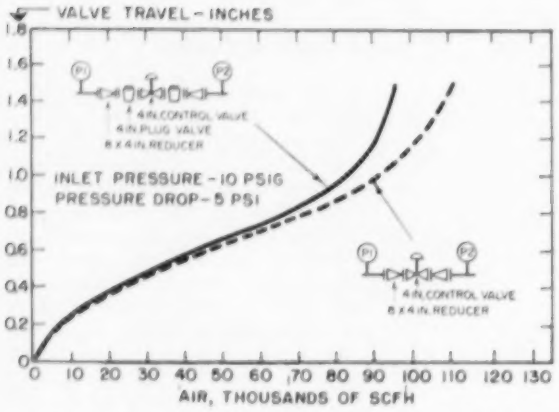

VALVE TRAVEL - INCHES
4 IN. CONTROL VALVE
4 IN. PLUG VALVE
8 X 4 IN. REDUCER
INLET PRESSURE - 10 PSIG
PRESSURE DROP - 5 PSI
AIR, THOUSANDS OF SCFH

FIG. 6—Low pressure drop for single-ported valve

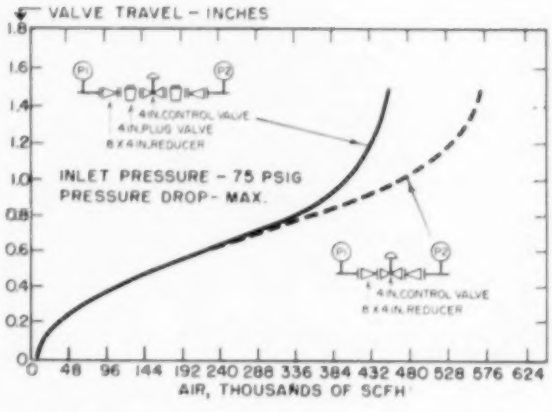

VALVE TRAVEL - INCHES
4 IN. CONTROL VALVE
4 IN. PLUG VALVE
8 X 4 IN. REDUCER
INLET PRESSURE - 75 PSIG
PRESSURE DROP - MAX.
AIR, THOUSANDS OF SCFH

FIG. 7—Critical pressure drop for single-ported valve

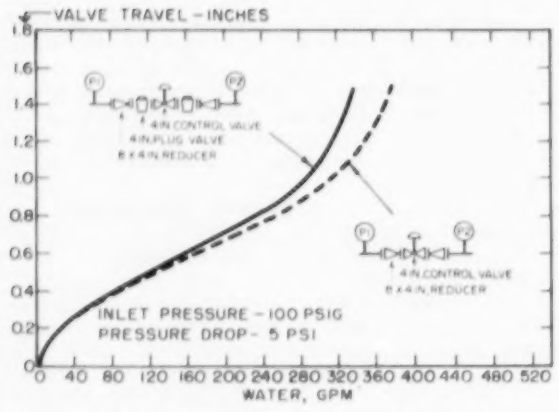

VALVE TRAVEL - INCHES
4 IN. CONTROL VALVE
4 IN. PLUG VALVE
8 X 4 IN. REDUCER
INLET PRESSURE - 100 PSIG
PRESSURE DROP - 5 PSI
WATER, GPM

FIG. 8—Water flow for single-ported valve

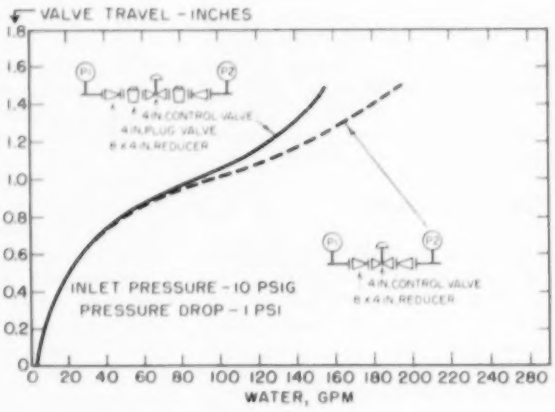


FIG. 9—Water flow for double-ported valve

lar to those on the 4-in. line, but effects on capacity and characteristic are much larger.

Low pressure drop. Using 10 psig inlet air and a one psi pressure drop, Fig. 6 shows a 13.5% capacity loss and a large change in control valve characteristic in the last third of the stroke when plug cocks are used.

Critical pressure drop. Increasing air pressure to 75 psig and pressure drop to maximum gives a curve similar to the low pressure drop case, with poor control characteristic for the last third of the stroke. But capacity loss is now about 21%, shown in Fig. 7. The same results are found if a 4-in. double-ported control valve is used.

Water flow. With 100 psig inlet water as the flowing medium, and a 5 psi pressure drop, capacity loss is a little over 10%, shown in Fig. 8. Using a double-ported control valve, 10 psig water and a one psi pressure drop gives similar results, shown in Fig. 9.

U-BEND MANIFOLDS

4-Inch Lines

The U-type control-valve manifold (shown in Figs. 10-15) is probably the most common arrangement in use, therefore it too was tested extensively.

The tests were divided into two series. Series one used a 2-in. control valve in a 4-in. line with line-sized plug cocks, 4 x 2-in. concentric reducers at the valve inlet and 4-in. standard-radius elbows.

Series 2 used a 2-in. control valve in a 4-in. line, 4-in. line-sized plug valves, 4 x 2-in. concentric reducers, and 2-in. standard-radius elbows.

Both series of tests are plotted on the same graph for the same pressure conditions. The effects of the "tee" fittings sometimes used in such a manifold were not included.

Low pressure drop. Fig. 10 shows that for 10 psig inlet air and one psi pressure drop, 2-in. elbows give a capacity loss of 17% in a single-ported valve, much greater than for 4-in. elbows. But more important, for the 2-in. elbow, the valve characteristic is greatly altered for the full range of

2-Inch Control-Valve Characteristic Curves, 4-in. line, with 2-in. elbows before and 4-in. elbows after reducers

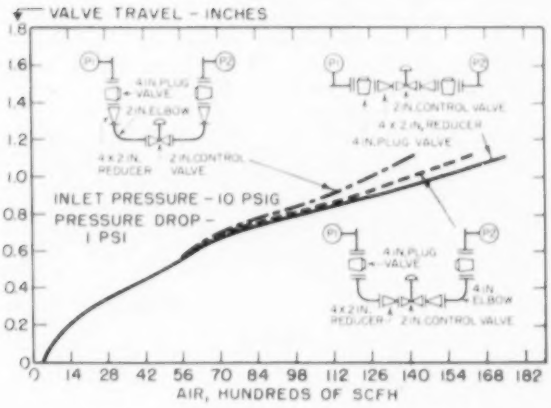


FIG. 10—Low pressure drop for single-ported valve

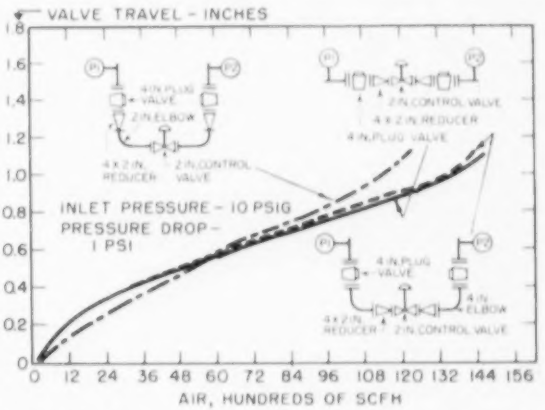


FIG. 11—Low pressure drop for double-ported valve

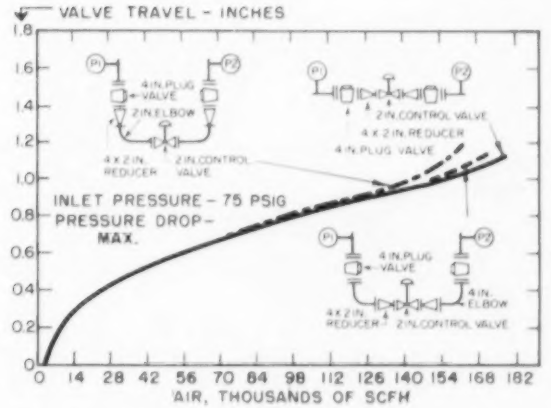


FIG. 12—Critical pressure drop for single-ported valve

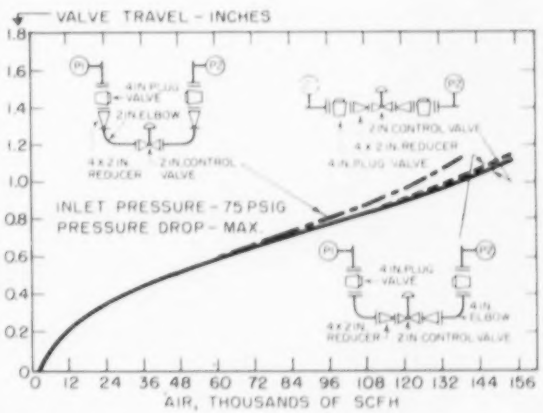


FIG. 13—Critical pressure drop for double-ported valve

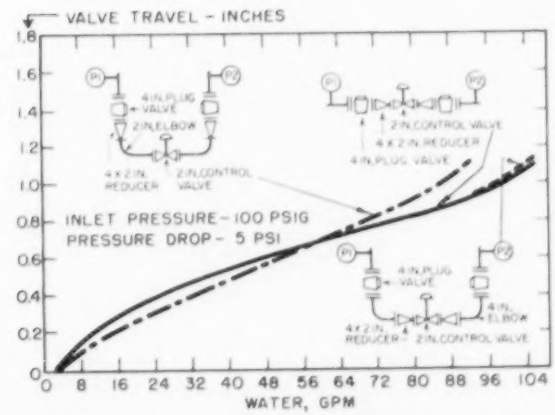


FIG. 14—Water flow for single-ported valve

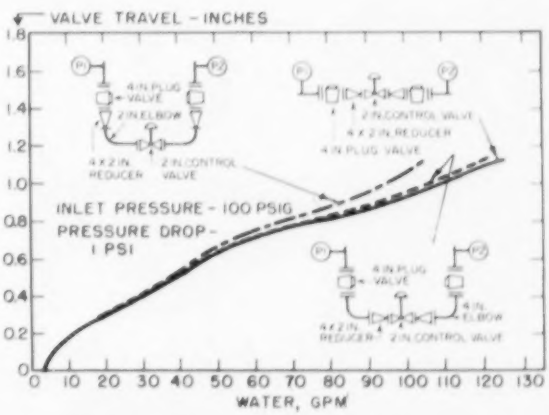


FIG. 15—Water flow for double-ported valve

travel. A similar test for a double-ported valve shows a similar loss in capacity, but a much more constant valve characteristic, shown in Fig. 11.

Critical pressure drop. For 75 psig inlet air and maximum pressure drop, capacity loss is less and valve characteristic better than for the low pressure drop case, shown in Fig. 12 for a single-ported valve and in Fig. 13 for double-ported valve.

Water flow. In this series of tests, the most interesting results for liquid flows were noticed. Referring to Fig. 14 (2-in. single-ported valve) there is no effect from the use of 4-in. elbows. When the 2-in. elbows are used, however, an almost straight-line characteristic results, and the capacity is reduced about 12%. Fig. 15, for the double-ported valve, shows similar capacity losses, but characteristic change is unimportant.

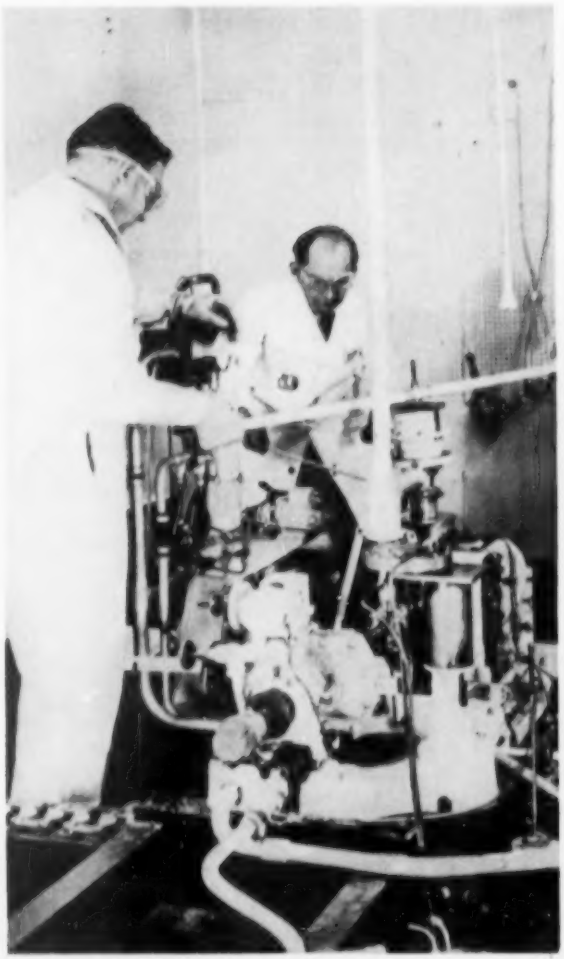
USING THE RESULTS

While the results of these tests might have been predicted for capacity losses, the changes in valve characteristic are not predictable. Though these tests used plug cocks as block valves, this same procedure can be used to study the effects of other types of valves and fittings.

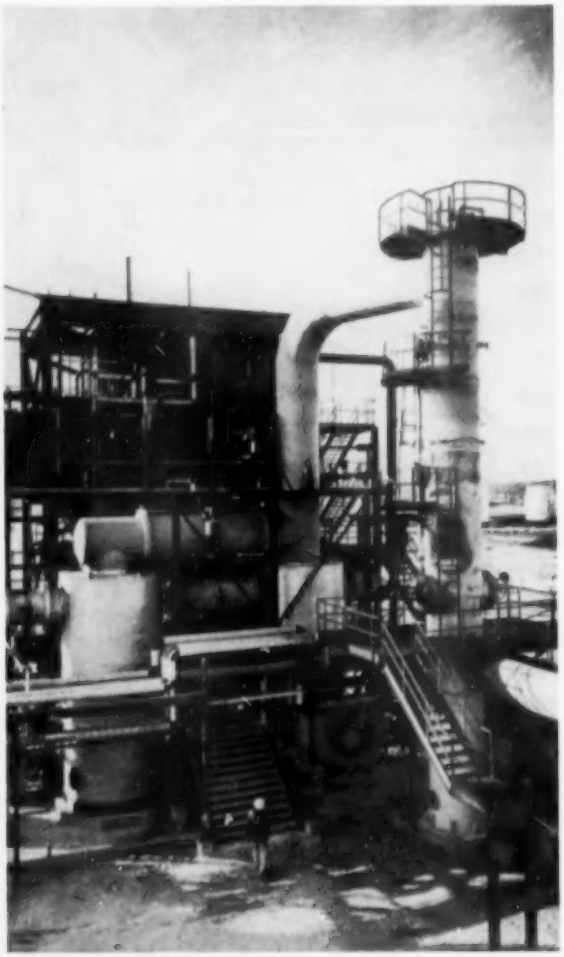
One note of interest, the common practice of reducing the size of the inlet and outlet blocks, as well as to add elbows in the manifold, will probably result in impared capacity and characteristic for the control valve, but time limited the scope of the tests available for this article.

This article is based on "Effects of Adjacent Piping Configuration on Control-Valve Characteristic and Capacity," by G. F. Brockett and W. J. L. Kennedy, presented the American Society of Mechanical Engineers Diamond Jubilee Annual Meeting, Chicago, Ill., Nov. 13-18, 1955.

NEWS in VIEWS



BRITISH USE RADIOISOTOPES to measure engine wear. Using protective equipment, technicians at British Petroleum Co.'s research station at Sunbury, near London, England, are shown fitting a radioactive piston ring to a special test engine.



DESIGNED FOR TWO PURPOSES, this new carbon monoxide boiler at Canadian Oil Cos. Ltd., Sarnia, Ont., reduces air pollution—by burning waste gases —and furnishes additional steam which was needed for a boost in refinery capacity.

GULF CRACKS THREE ETHYLENE FEED STOCKS INTERCHANGEABLY...

with SELAS GRADIATION®

Gulf Oil Corporation's new ethylene plant at Port Arthur, Tex., designed and constructed by Stone & Webster Engineering Corporation. Eight Selas Gradiation heaters are in center foreground.

The world's largest ethylene-producing plant benefits from the versatility of Selas Gradiation heaters. Three separate feed stocks—propane, ethane and propane-propylene mixtures—have been processed interchangeably in all of the eight Selas furnaces.

Operating results on all three feed stocks in the Gulf plant confirm that these Selas heaters provide:

- "On stream" periods, without shutdowns, well in excess of 30 days.
- High conversions and selectivity.
- Optimum conditions, even with extreme variations in feed stock.

Zone control of heat input, enabling Selas heaters to meet any time-temperature curve in pyrolytic or catalytic reactions and high-temperature preheating, is featured by:

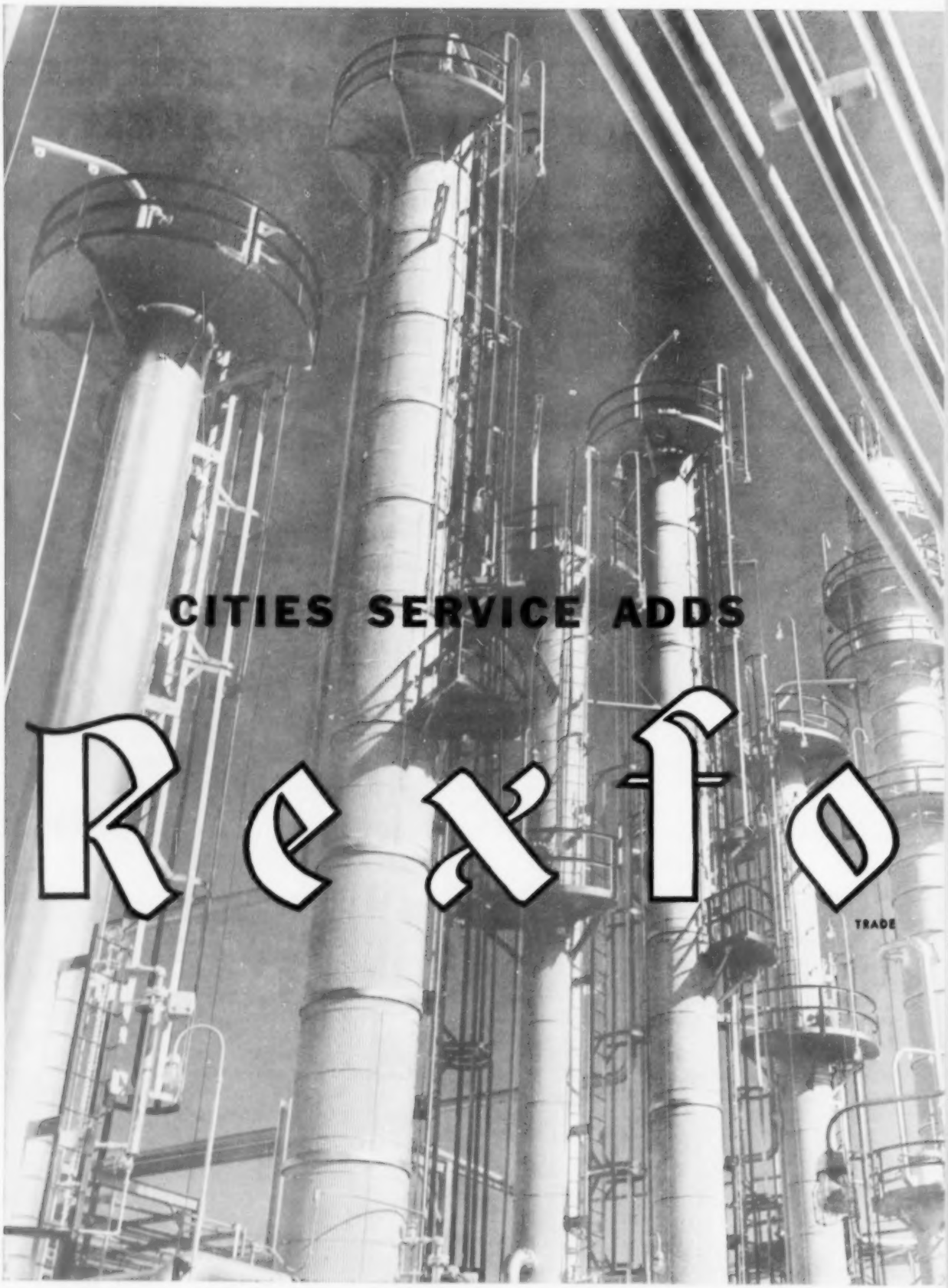
- Uniform heat distribution on the entire tube surface —eliminating local overheating, material degradation at the tube wall and, hence, longer tube life.
- Controlled combustion, with little or no excess air to cause external oxidation of the tubes . . . no lag in response to controller demand.

Send for copy of reprint, "Try the Gradiation Heater for Economical Ethylene Production" and Bulletin, "Gradiation Heating for Petroleum and Chemical Processing."

SELAS
CORPORATION OF AMERICA
PHILADELPHIA 34, PENNSYLVANIA

FLUID PROCESSING

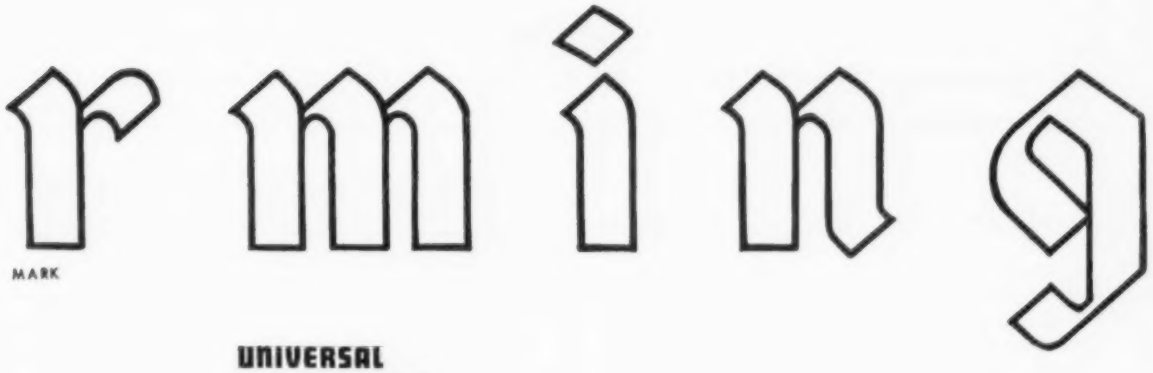
SELAS


CITIES SERVICE ADDS
Retro
TRADE

After an exhaustive study, Cities Service Oil Company (Del.) has chosen the UOP Rexforming process as the best method for upgrading low octane naphthas to meet the rapidly increasing demand for higher octane gasolines.

A 6,000 barrel per stream day Rexformer will be installed at Cities Service Ponca City, Okla., refinery as an important part of an extensive new construction and expansion program.

By installing the Rexforming process, the latest development in the catalytic reforming field, Cities Service will be assured of obtaining the best yields of the highest octane blending material for the company's motor fuels. Rexforming, developed by Universal, is capable of producing gasolines having octane ratings considerably in excess of 100 clear.



MARK

UNIVERSAL
OIL PRODUCTS
COMPANY

30 ALGONQUIN ROAD,
DES PLAINES, ILL., U.S.A.

Forty Years Of Leadership
In Petroleum Refining Technology

to remove

H_2S

CO_2

use

Monoethanolamine

Diethanolamine

high purity
NITROGEN DIVISION
chemicals

to remove

H_2O

use

Diethylene Glycol

Triethylene Glycol

high purity
NITROGEN DIVISION
chemicals

NITROGEN DIVISION ALLIED CHEMICAL

Maximize the purity of your gas stream, and minimize corrosion problems by using Nitrogen Division gas-treating chemicals. Free of unwanted chemical impurities – chlorides and acids – these products are consistently above standard purity specifications.

Call or write today for samples and quotations. Ask too for technical service to help adapt these high purity chemicals to your process.

NITROGEN DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.
Hopewell, Va. • Ironton, Ohio • Orange, Tex. • Omaha, Neb.

Allied Chemical

Maximize the purity of your gas stream, and minimize corrosion problems by using Nitrogen Division gas-treating chemicals. Free of unwanted chemical impurities – chlorides and acids – these products are consistently above standard purity specifications.

Call or write today for samples and quotations. Ask too for technical service to help adapt these high purity chemicals to your process.

NITROGEN DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.
Hopewell, Va. • Ironton, Ohio • Orange, Tex. • Omaha, Neb.

Anhydrous Ammonia • Ammonia Liquor • Ammonium Sulfate • Sodium Nitrate • Methanol • Urea
Ethanolamines • Ethylene Oxide • Ethylene Glycols • Formaldehyde • Nitrogen Tetroxide
Nitrogen Solutions • U.F. Concentrate–85 • Fertilizers & Feed Supplements

Your Guide to . Petroleum Processing

Departments

Your "Clip-n-File" Process Data

This new special department, perforated for quick and easy removal for your own process handbook. This month's subject: p. 89

Anhydrous Ammonia by the L'Azote Process

Managing Maintenance

. . . doesn't have to be a continuous battle against emergencies. It can be planned, standardized, predicted, and measured. This is the gist of a new book describing "Techniques of Plant Maintenance and Engineering," reviewed this month p. 109

NEW

And Here's Another "Clip-n-File"

A new feature this month — and every month from now on — is this two-page engineering data sheet. Like the monthly process data sheet, it too has been designed for your convenience. It is perforated for easy removal, and punch holes are indicated so it can be kept in a loose-leaf binder. This month's topic:

Pressure Fundamentals

What pressure is, how it is measured, the units of measurement, and some handy tables of equivalents p. 101

Send Drawings, Photos by Radio

New microwave unit permits long distance transmission of drawings, maps, or pictures over conventional radio circuits. See What's New! for this and more than 50 other new ideas in equipment, supplies, and helpful literature. p. 129

Handy Jig Makes Pipe Saddles

You could put this one together from scrap to be found around your own shop. That's what Cosden did. See Plant Practices for this and three other ideas — a portable welding fume vent, quick way to make slagging chisels, and how to truck transite. p. 93

INDEX TO ALL DEPARTMENTS

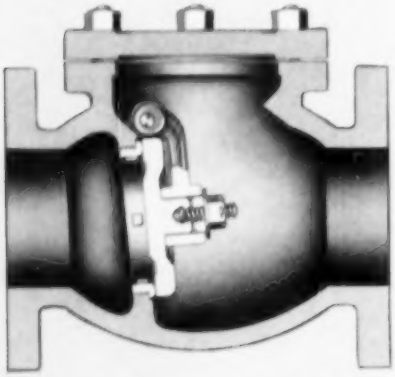
"Clip-n-File" Process Data	89
Plant Practices	93
Operating Trends	97
"Clip-n-File" Engineering Data	101
Personals	105
New Words in Your Reading	109
Patents	111
Suppliers	117
Meetings	121
Books	123
Information Offered	124
Advertisers' Index	126
What's New!	129
Editorials	160

Economy Buy for Many Process Services

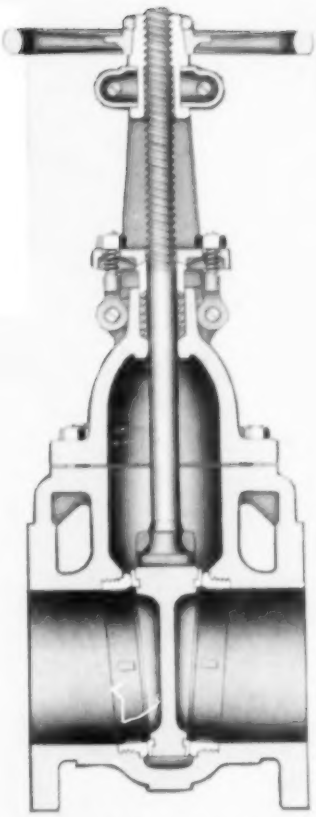
IN PULP AND PAPER, WOOD TREATING, CHEMICAL, PETROLEUM, ETC.

WORKING PRESSURES: GATES AND CHECKS

12 in. and smaller—200 psi W.O.G.
14 in. and larger—150 psi W.O.G.



Cross section, Check, No. 14493
Flanged ends



Cross section, Gate, No. 14477
Flanged ends

Crane Nickel Cast Iron Valves
IMMEDIATE DELIVERY from Factory Stocks

Why wait for low nickel alloy cast iron valves when you can get Crane quality—at no extra cost—immediately from factory stocks? Gates on hand in sizes: 2″—2½″—3″—4″—6″—8″—10″—12″—14″—16″—18″. Checks in all the same sizes up to 12″ incl. (14″—16″—18″ will be made to order). This delivery offer good while present stocks last.

These valves have an outstanding record in the pulp and paper industry in handling various alkaline liquors. In wood treating they're used successfully on creosote vapors and oils. They're ideal, in the petroleum industry, for handling oils containing traces of mineral acids. Crane 18-8 SMo alloy trim in these valves combines with nickel alloy body to assure tight seating and smooth, maintenance-free operation. The gates have Crane features such as: full-length disc guides . . . 2-piece ball-type gland . . . T-head disc-stem connection.

The checks feature all 18-8 SMo trim, including body ring, disc, hinge and hinge pin in sizes 2 to 12 inches. Valves 14 inches and larger have disc same as body, with 18-8 SMo disc faces.

You'll save with these valves on original cost and maintenance. Call a Crane Representative for immediate delivery! Crane Co., General Offices, Chicago 5. Branches and Wholesalers in all industrial areas.

CRANE *Since 1855*

VALVES & FITTINGS • *PIPE* • *KITCHENS* • *PLUMBING* • *HEATING*

START HERE

Process—Direct production of anhydrous ammonia by the Societe Belge de L'Azote process.

Process Flow—Hydrogen from a gas-separation and purification plant is scrubbed with liquid nitrogen from an air separation plant to remove remaining traces of methane, carbon monoxide, etc. The composition of the hydrogen-nitrogen mixture leaving the scrubber is adjusted to three volumes of hydrogen and one volume of nitrogen by adding nitrogen in the scrubber. The refrigeration of the synthesis-gas stream is used for cooling in the hydrogen-purification section. Purified synthesis gas is then compressed to a converter pressure of about 250-300 atmospheres, and passed through an oil filter to remove oil or foreign materials in the synthesis gas.

Synthesis-gas feed then joins recycle synthesis gas. The mixture enters the synthesis converter—a multi-purpose unit, see Equipment—and passes through the feed-product heat exchanger, then through the catalyst element tubes to bring the gases to about 850-1000°F. Following preheat, the feed gases pass through the catalyst bed, counter-current to the flow of gas through the tubes.

Product gases from the converter pass through the steam generator to the economizer, then to the feed-product heat exchanger. Product leaves the converter vessel at about 200°F, and is cooled further to about 75°F by cooling water and refrigeration, as needed.

An ammonia separator divides the liquid ammonia product from the unreacted hydrogen and nitrogen, which are then compressed to operating pressure before mixing with fresh synthesis-gas feed. A small portion of recycle gas is bled continuously from the recycle loop to prevent build up of inerts, argon, etc. The bleed stream joins gases liberated from the liquid ammonia during the pressure reduction.

Liquid ammonia product collecting in the base of the ammonia separator is automatically discharged to a let-down tank, reducing pressure from about 250-300 atmospheres to about 20 atmospheres. In the let-down tank, dissolved gases—nitrogen, hydrogen, and inerts—are liberated along with some vapors from the ammonia product. The vented gases are collected and cooled, the condensed ammonia being returned to the product and the rest returned to the hydrogen purification system, or vented. The vented gases amount to about 1% of the fresh synthesis-gas feed.

Raw Materials—Hydrogen and nitrogen are the only raw materials needed. Hydrogen may be from coke-oven gas, refinery off-gas, natural gas, liquid petroleum fractions, blue-water gas, etc. The hydrogen must be separated from other gases and purified to remove hydrogen sulfide, carbon monoxide, carbon dioxide, oxygen, water vapor, and hydrocarbons. The final purification step is often a liquid nitrogen wash which removes the last traces of impurities and mixes nitrogen with hydrogen. Nitrogen is commonly obtained from an air separation plant, and should be 99.99% pure with only traces of inerts such as argon, krypton.

Catalyst—Usually an activated iron catalyst is used to synthesize ammonia. However, catalyst activators are used to promote product formation, and include oxides of calcium, potassium, aluminum, etc. Requirements for a good catalyst include high activity at low operating temperatures, relatively constant activity over long operating periods, resistance to poisoning by trace feed impurities and physical strength to prevent abrasion loss.

Initial catalyst charge is about 100 lb. of catalyst/daily ton of ammonia produced. Under normal conditions, less than 0.1 lb. catalyst/ton of ammonia produced is consumed. Life for the initial catalyst charge is 5-8 years.

The catalyst is low-cost and easy to obtain. Plant catalyst regeneration is not provided as the spent catalyst is discarded. Handling is simple as the catalyst is in a cartridge which is readily removed from the reactor. Catalyst life is prolonged by maintaining stable operating temperatures throughout the entire catalyst mass.

Operating Conditions—An economic study based on operating experience with a well purified synthesis gas indicates the greatest economy at pressures of 250-300 atmospheres and converter temperatures of 880-890°F.

Conversion efficiencies are about 25-28% per pass. The recycle gas is 2.50 to 3.00 times the feed gas. Operating conversion efficiencies are high and approach theoretical equilibrium conversions.

Process Variables—Primary variables are synthesis-gas feed purity and composition, temperature, pressure and throughput.

Catalyst poisons in the feed gas decrease catalyst life, and other impurities decrease conversion per pass slightly.

Conversion efficiency drops if there is great deviation from the one part nitrogen to three parts hydrogen mixture.

Temperature affects both reaction rate and reaction equilibrium, so it is important to keep the entire catalyst bed at a constant temperature. Reaction rate increases with temperature, but the value of high temperature is partially offset by a decrease in equilibrium constant. The reaction rate also decreases as the conversion approaches equilibrium conditions.

Feed conversion is directly proportional to pressure at constant temperature. Assuming 842°F, feed to product conversion is 16% at 1500 psig and 53% at 9000 psig. However, the economics of reactor design do not permit the large times needed to reach equilibrium conditions.

Higher pressures give additional conversion per pass, but are costly. However, actual operations using a well purified feed stock clearly indicate the most economical operating pressure to be between 250 and 300 atmospheres.

Product—Anhydrous ammonia yield, based on hydrogen and nitrogen entering the system, is about 98.7%. The remaining 1.3% gases are those vented from the recycle gas and released from the liquid ammonia when product pressure is reduced from converter to storage pressure.

Typical anhydrous ammonia product is:

Ammonia	99.9 vol.% (min.)
Water	0.1 vol.% (max.)
Oil	3 parts/million (max.)
Chlorides	None
Pyridine	None
Non-condensables	0.1 cc/gram of NH_3 (max.)

Oxygen from the nitrogen-producing air separation plant can be used for the partial combustion of natural gas or petroleum distillates to produce hydrogen or acetylene.

Equipment—The hydrogen purification system equipment is similar to that used in low temperature separation plants today.

The ammonia converter is multi-purpose with removable elements, and contains a feed-product heat exchanger, removable catalyst cartridge, steam generator, economizer and an electrical start-up heating element.

The catalyst cartridge has a catalyst bed surrounding a number of tubes. Feed gas is preheated by passing through the tubes and absorbing heat of reaction from the catalyst bed. This keeps the catalyst bed at a constant temperature.

Synthesis-gas compressors are reciprocating. A multi-stage centrifugal compressor is used for recycle gas to prevent oil from entering the process stream and eliminate oil filters following the compressor.

High pressure vessels and equipment are made from forged steel, multi-layer or wrapped construction.

The internal arrangement of converter passages are so that the steam generator and economizer are by-passed during start-up. This insures that all heat generated during the start-up is used to bring the process portion of the converter to equilibrium as soon as possible.

Economics—Investment is about $32/annual ton of ammonia for a 33,000 ton/yr. plant and about $25/annual ton for a 100,000 ton/yr. plant. These costs assume a new plant site, and include all "on-battery" equipment and buildings. Equipment includes compressors, oil separators, reactors, cooling coils, vent system, etc., but does not include product storage or distribution facilities.

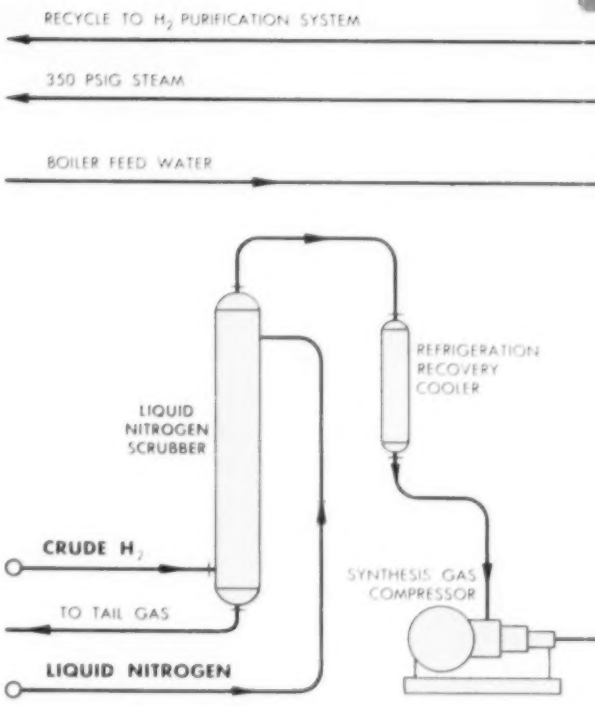
Manpower for a 300 ton/day plant includes operation labor of 2 men per shift and maintenance and repair of about 2-3% of investment.

Comparative costs for anhydrous ammonia from a variety of hydrogen-containing gases by the Societe Belge de L'Azote synthesis loop are:

Hydrogen Source	Approximate Production Cost $/ton
Refinery off-gas	30
Coke-oven gas*	34
Natural gas	42
Fuel oil	48
Coal	55
Coke	60

* May be reduced to about $26/ton by use of by-products recovered from coke-oven gas separation.

The above are approximate and will vary between installations. Fuel cost is based on coal at 18¢/MMBtu, coke and other fuels at 30¢/MMBtu.



Utilities—One ton of ammonia product needs:

Service water	12,800 gal.
Boiler feed water	165 gal.
Electricity	350 kwh
Net steam produced for use elsewhere, 350 psig	1,380 lb.

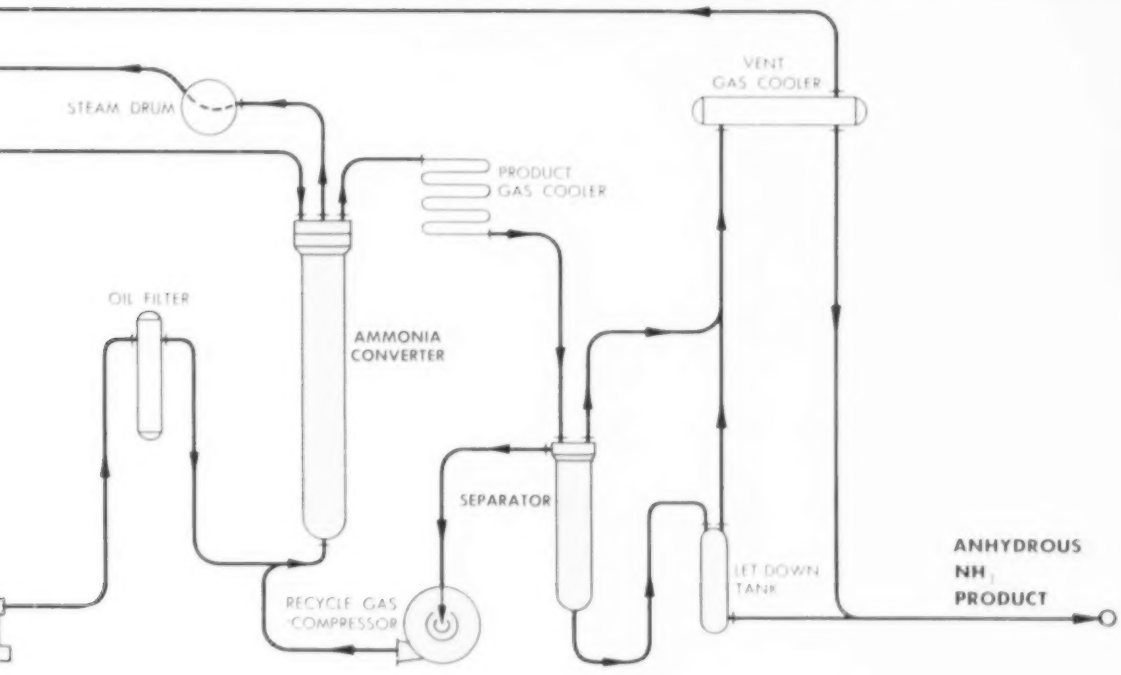
Installations—Societe Belge de L'Azote was one of the first European firms to produce ammonia from hydrogen in coke-oven gas, and has been continuously improving the process for over 30 years. The most recent installation in Europe went on-stream during 1955.

Licensor—Engineering and Construction Div. of Koppers Co., Inc., Pittsburgh 19, Pa. Koppers recently received North American continent licensing rights along with design and "know how" information from Societe Belge de L'Azote.

References—Further information can be found in:

(1) Ullman's Encyklopadie der Technischen Chemie 3 Band 1953, pp. 544-588.
(2)† Vollmer, R. W. and W. E. Simmat, "Economic Aspects of Coal Chemicals from Coke-Oven Gas," presented at American Institute of Mining and Metallurgical Engineers, Apr. 19, 1955.
(3)† Vollmer, R. W. and W. E. Simmat, "Synthetic Ammonia—A Future By-Product of the Steel Industry," presented at Blast Furnace and Coke Assn. of Chicago, Ill., Jan. 20, 1955.

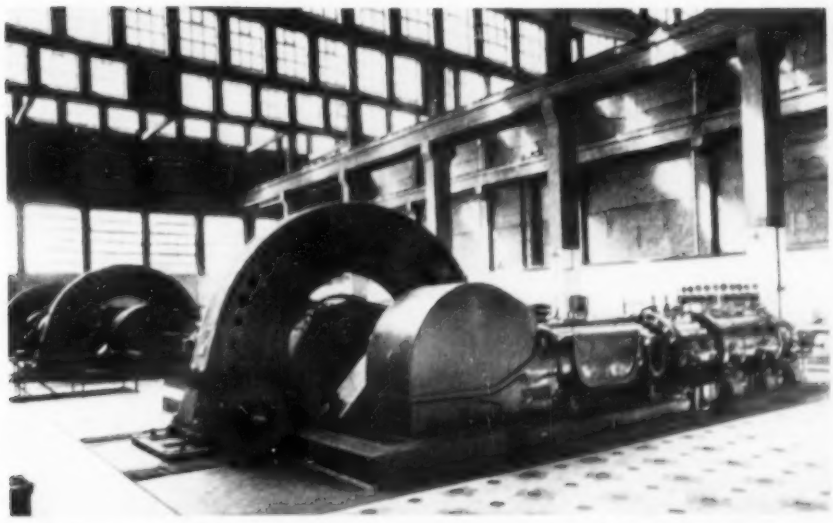
†Copies available from E. & C. Div. of Koppers.



Anhydrous Ammonia

By the Societe Belge de L'Azote Process

UNFOLD FOR START OF PROCESS DESCRIPTION



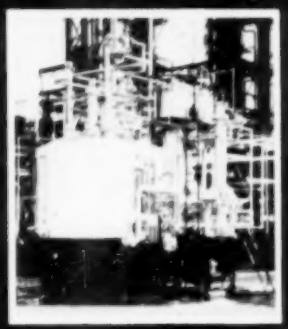
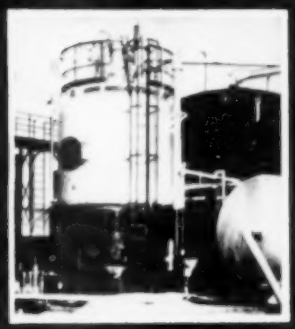
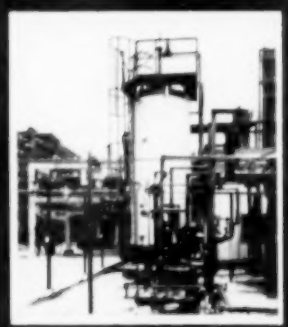
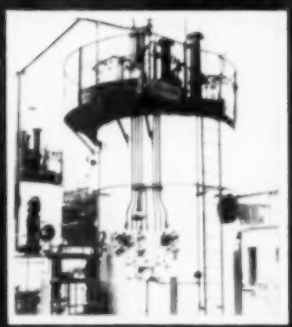
SYNTHESIS GAS COMPRESSORS used in European installation. These compressors compress synthesis-gas feed to the converter pressure of 250-300 atmospheres

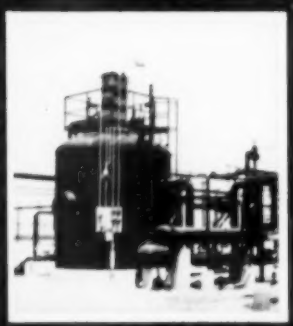
BECAUSE OF THESE ADVANTAGES

more and more refiners are specifying

PETRECO ELECTROFINING

- Single vessel, one pass operation
- Automatic control
- Continuous process
- Intensive contacting
- Closed system, no fumes
- Minimum caustic and/or acid usage
- Low entrainment loss
- Minimum operating attention
- Small space requirement
- Purchase or rental option
- Always available service



APPLICABLE FOR

- Caustic scrubbing
- Acid contacting
- Water washing
- Doctor treating
- Nitrogen base removal
- Jet fuel treating
- Cat cycle treating
- Furnace oil improvement

Specialized Electric Petroleum Processing

DEHYDRATING • DESALTING • LUBE OIL TREATING

DISTILLATE TREATING • SEDIMENT SEPARATION

DESAPONIFICATION

DT-4

For complete information, write or call

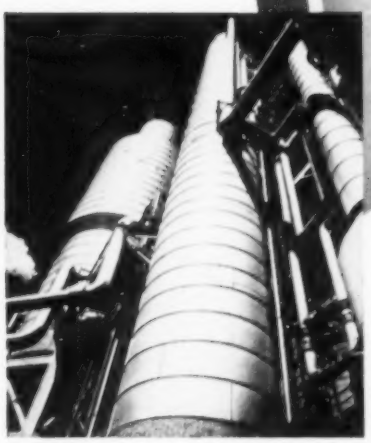
PETRECO

A DIVISION OF PETROLITE CORPORATION

3202 So. Wayside Drive, Houston 1, Texas

1390 East Burnett Street, Long Beach 6, California

STRUCTURAL STABILITY—
Low-cost carbon steel backing provides necessary strength and rigidity.
DESIGN FREEDOM—
Integral bond allows design and fabrication of shapes to meet process and space needs.
ECONOMY—
High-alloy layer assures corrosion resistance, long equipment life.



Stainless-clad and monel-clad steels combine to handle corrosive asphalt crude containing up to 2.5% sulfur concentrations at 750° F in this vacuum still.

CLAD STEEL EQUIPMENT GIVES SOLID HIGH-ALLOY PROTECTION

AT LOWER COST

With protection against the corrosive action of sulfuric feeds at high temperatures a "must" to avoid unscheduled shutdowns, clad steel equipment is often the *economical* answer. Cladding and backing are permanently and integrally bonded over their entire surface, eliminate the chance of seepage or crevice corrosion. Smooth, uniform clad surfaces permit easy cleaning, drainage and inspection.

Why not investigate clad for your new processing equipment. Lukens Clad Steels—stainless, nickel, Inconel, Monel, copper—give you all the advantages of these solid high-alloys with savings up to 50% in material costs.

In addition to low first cost, clad steel permits easy and economical field erection. When you're thinking of new tanks and pressure vessels, *qualified* equipment builders can help you take advantage of the versatility of Lukens Clad Steels. Working with your engineers and consultants from the start, they tailor equipment to your exact needs. We offer the widest range of clad steels available and work closely with fabricators to help select the type most suited to your processing needs. If you would like further information, ask one of your builders or write Manager, Marketing Service, Lukens Steel Company, 752 Lukens Building, Coatesville, Pennsylvania.

LUKENS CLAD STEELS

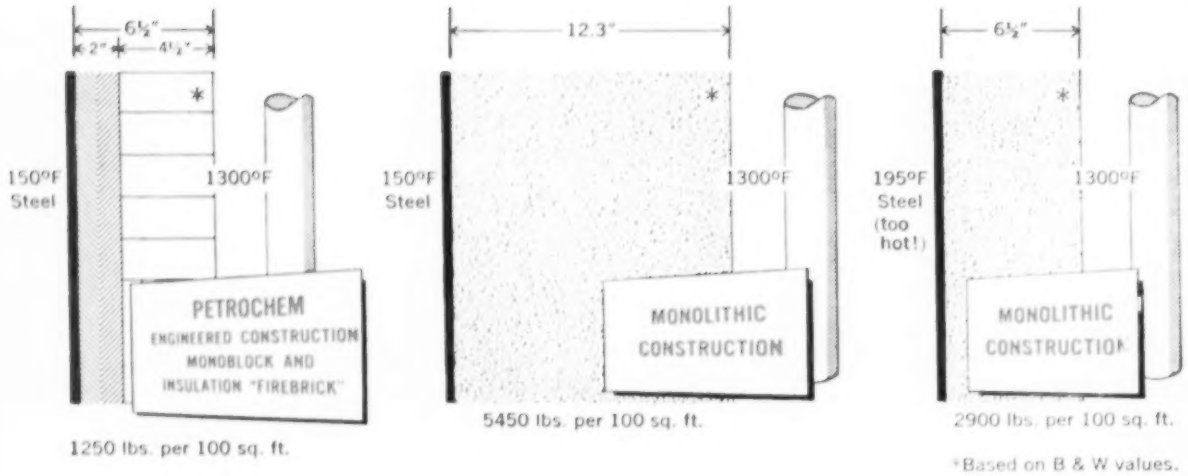
STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEEL PLATES AND HEADS AVAILABLE

In furnaces as in processes compare the design to judge the advantages

As an example:

The wall construction of all Petrochem-Isoflow Furnaces is designed for 150°F maximum outside shell temperature.



*Based on B & W values.

The Petro-Chem design provides a thoroughly engineered wall construction. It is built with two tiers of monoblock supported on 18 inch centers and a circular arched wall of insulating firebrick. The inside of the steel shell is protected from the possibility of corrosion by a one-eighth inch thickness of Staylastic cement. This type of construction, independently supported monoblock and the circular arch of firebrick, bonded with Smoothset mortar, assures optimum efficiency and minimum maintenance.

The use of monoblock and insulating firebrick laid as a circular arch provides many advantages over a one-piece monolithic lining, including:

1—Low weight, 2—Low heat conductivity, 3—High hot crushing strength, 4—Low expansion coefficient, 5—Resilient compressible backing, 6—Long life, 7—Nil maintenance.

Also, this construction has low heat storage capacity, speeds both heating and cooling. Its light weight requires less concrete foundations and steel supports.

Compare and your judgment will affirm
Petrochem-Isoflow Furnaces are Most Efficient by any Comparison

PETROCHEM-ISOFLOW FURNACES

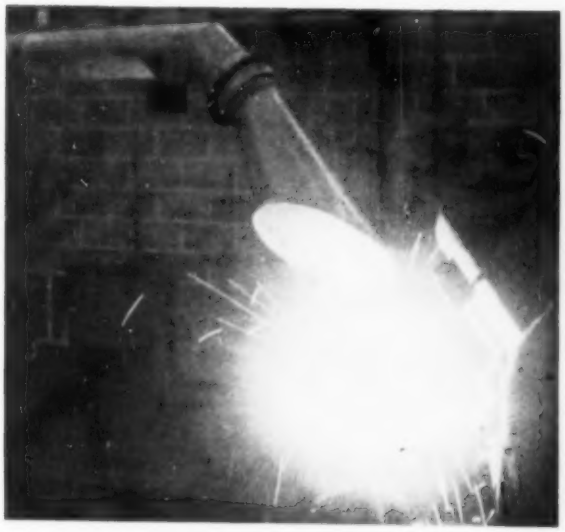
UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

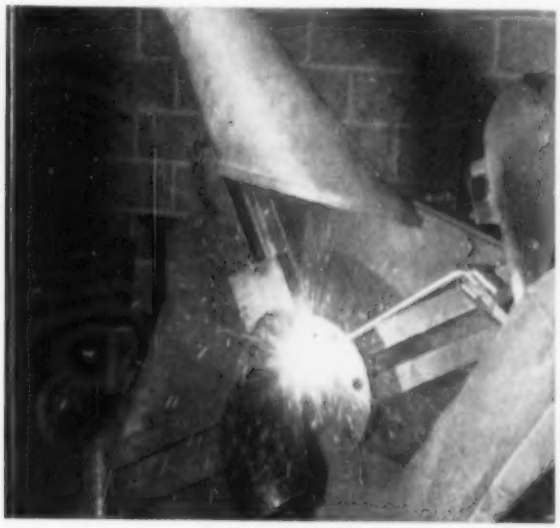
PETRO-CHEM DEVELOPMENT CO., INC. • 122 EAST 42nd St., New York 17, N. Y.

REPRESENTATIVES: Rawson & Co., *Houston* • Wm. H. Mason Co., *Tulsa* • Lester Oberholtz, *Los Angeles* • Faville-Levally, *Chicago* • D. D. Foster, *Pittsburgh* • Turbex, *Philadelphia* • Flagg, Brackett & Durgin, *Boston*

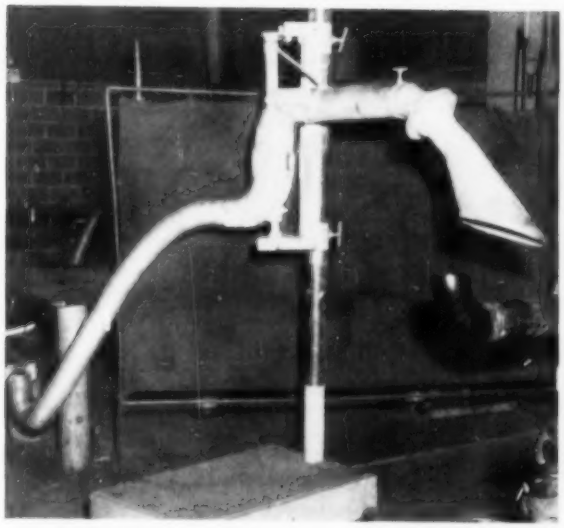
International Licensees and Representatives: SETEA — S.A. Commercial, Industrial, y de Estudios Tecnicos, Buenos Aires, Argentine • Industrial Proveedora, Caracas, Venezuela • Firma Dr. C. Otto & Comp. G.M.B.H., Germany • Birwelco Ltd., Birmingham, England • Societe Anonyme Heurtey, Paris, France • Societe Anonyme Belge, Liege, Belgium • Huertey Italiana S.P.A., Milan, Italy

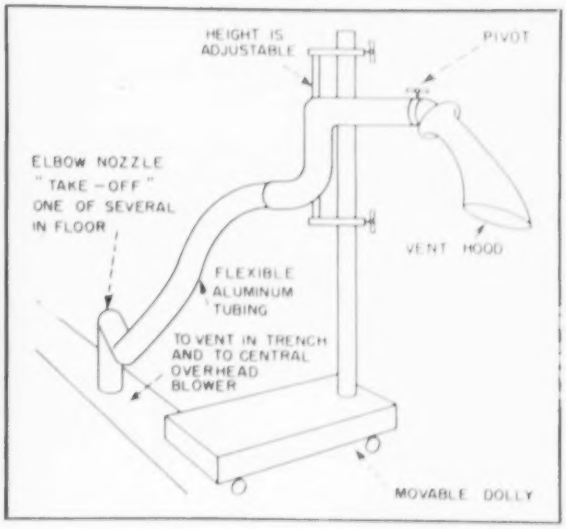
(To obtain more data on advertised products see page 126)





For Fume-Free Welding Anywhere in the Shop




HEIGHT IS ADJUSTABLE
PIVOT
ELBOW NOZZLE "TAKE-OFF" ONE OF SEVERAL IN FLOOR
VENT HOOD
FLEXIBLE ALUMINUM TUBING
TO VENT IN TRENCH AND TO CENTRAL OVERHEAD BLOWER
MOVABLE DOLLY

. . . Try This Portable Venting System

THE welding area of Socony Mobil Oil Co.'s East Chicago, Ind., refinery maintenance shops needed a blower system to remove localized fumes, smoke, and annoying gases.

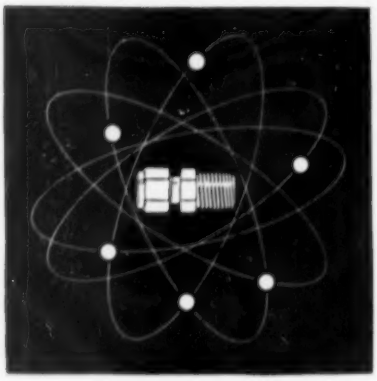
Because of the shop arrangement and space limitations, it was not desirable to mount multiple blowers and exhaust ducts along the shop walls. In addition, Socony wanted as much flexibility as possible for the optimum location of welding benches with respect to the overhead cranes.

Portable fume "pick-ups" solved their problem. A pick-up (as shown in the lower pair of illustrations above) consists of a small hood connected to a length of 4-in. flexible aluminum piping. The entire assembly is movable vertically on its support, which in turn is mounted on a wheeled base member.

In the utilities trenches which criss-cross the floor of the shop, duct work has been installed, leading to a single central blower mounted in an out-of-the-way position high on one shop wall. At strategic positions around the shop area, 4-in. elbow-nozzle "take-offs" are permanently connected into the duct work in the trench. When not in use, these take-offs are covered.

During welding—or any other fume-

NOW Swagelok®
TUBE FITTINGS FROM
ALUMINUM
TO
Brass, Carpenter 20, Gold, Hastelloy, Inconel, Monel, Nickel, Platinum, Silver, Stainless Steel, Steel, Tantalum, Teflon, Titanium, Zirconium
ZYTEL*
POLYAMIDE RESIN



From aluminum to "Zytel" there's a Swagelok answer to your fitting problems. The new Swagelok Tube Fittings of "Zytel" are for use with plastic tubing in applications where corrosion is a problem. They are the first to be made in a complete range of shapes that include elbows, tees, reducers and adapters.

The new Swagelok Tube Fittings of "Zytel" are made to the unique Swagelok patented design that provides strong, torque-free and leakproof joints at all tubing connections. Sleeves or inserts are unnecessary. Specify Swagelok for every fitting need and eliminate unnecessary fitting problems.

FREE: For complete information write for the Swagelok catalog. Address Dept. D-41

Swagelok Tube Fittings Are
Easy to Use
No Special Tools Needed
No Flaring or Threading

*DuPont trade-mark

CRAWFORD FITTING CO.
884 E. 140th Street
Cleveland 10, Ohio

producing activity for that matter—a portable pick-up is wheeled into position. The aluminum piping is then slipped into place over the nearest take-off, and the overhead blower is started. All the welding fumes are collected by the pick-up hood, and discharged safely by the overhead blower.

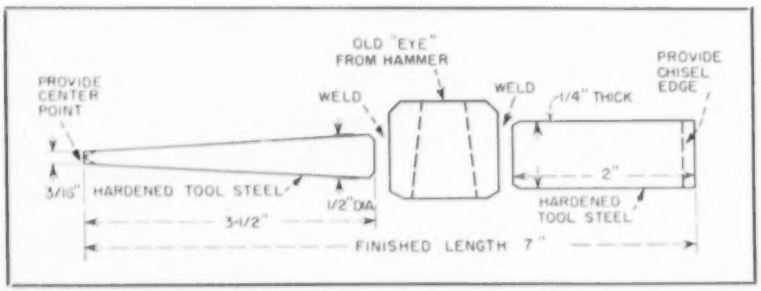
Simple Jig for Pipe Saddles

THERE are many ways to make pipe-saddles but the system used at Cosden Petroleum Corp.'s Big Spring, Texas, refinery will take prizes for ease and ingenuity. Saddles of almost any size and width may be made with ease.

The jig consists of a large V-shaped foot on the end of the piston rod of an air-operated railroad car brake cylinder, bearing against a triangular upright fixed in a slab of 1-in. thick steel plate. The business-end is shown in the accompanying photograph, which shows how it was made (brake cylinder not shown).

A section of the correct size of pipe is placed against the upright, and next the piece of plate to be formed into a saddle. The cylinder is actuated to bring the foot against the section of pipe, leaving the air "on." The saddle is formed by simply "wrapping" the plate around the section of pipe, most of which is done by the V-shaped foot, and bending out the ends for the clamping bolts.

Heating is not necessary for small saddles, though it is desirable for large ones, such as the 16-in. saddle in the photograph. In the large sizes, the ends are bent before being clamped on the forming-die.



Slag Chisels from Hammer Eyes

THE "eyes" from old hammers are used at Cosden Petroleum Corp.'s Big Spring, Texas, refinery to make excellent slagging chisels for welders. Any good refinery blacksmith can do the same. The design shown in the drawing above is an excellent tool for chipping slag from weld beads with the pointed end, and for knocking off larger chunks with the chisel end. Damaged chisels are easiest repaired by burning off the damaged ends near the eye and welding on a new part.

The two ends for the chisel are

forged from tool steel, the point being about 3½ in. long and the chisel about 2 in. These dimensions may be adjusted to the welders' preferences if desired. The pointed end should be provided with a center point. Both parts should be beveled for welding. The tool-steel should then be hardened to the tempering requirements of the particular steel used.

The "eye" from an old hammer is beveled for welding, preferably by grinding, and then the two ends are welded in place. It is optional with the welder whether the chisel edge is welded on in the plane formed by the handle, or at a right angle. In the latter case, a shape similar to the claw of a carpenter's hammer may be preferable to that shown in the drawing.

A stock of these ends is kept on hand at all times at the Cosden plant. The blacksmith makes these, conventional chisels, punches, and other small tools as part of his "slack-time" chores.

How to Tote Transite By Fork Lift Truck

By C. HOBAUGH

THE Sinclair Refining Co. refinery at Marcus Hook, Penna., uses a large amount of corrugated "Transite" for roofing and siding throughout the plant. As received, the sheets are closely stacked on trailers. Because the material is brittle, tedious unloading by hand is required.

By means of a procedure for handling the Transite by fork lift truck which was developed at the refinery, two men can unload 9 ton/hr. The way it's done is this: A fork lift truck presses both fork tips against the side of the stack of Transite sheets. Exerting a uniform force, it elevates slowly. Then, two pieces of 2 x 4 in. lumber, about 2 ft. long are slipped into the resultant opening.

When the pile is lowered, the sheets separate neatly. The forks are then easily inserted into the slot to move the isolated pile. Thus far, in using this technique, Sinclair personnel have been able to restrict damage to the brittle sheets to slight scratches inflicted by the forks.

The preceding item was prepared by PETROLEUM PROCESSING by Mr. C. Hobaugh, materials handling engineer, Sinclair Refining Co., Marcus Hook, Pa.

"Soyez les Bienvenus à Montréal au Mois de Mai!"

Amazing NEW Oakite

RUSTRIPPER

...Slashes tower down-time by more than 25%!

Texas refinery saves $1200 in ONE cleaning operation

Refiners everywhere are finding more and more uses for revolutionary Oakite RUSTRIPPER. This remarkable NEW alkaline material simplifies practically every cleaning job... reduces costs, too. Here's how amazing Oakite RUSTRIPPER saved one Texas refiner $1200 in a *single* cleaning operation:

The problem was to recondition a 28-tray, 5 man-way oil absorber tower containing 2304 four-inch bubble caps. Last cleaning had taken 24 hours —an extremely expensive proposition, since every hour of down-time costs this refinery $100! The superintendent agreed to give Oakite RUSTRIPPER a try.

After rinsing the tower with steam and hot water for two hours, a pre-mixed solution of Oakite RUSTRIPPER was pumped into the unit from a 1000-gallon tank mounted on skids nearby. The solution was recirculated and agitated for ten hours at 210°, then routed through the mist extracter for an additional three hours, and drained out. A three-hour circulating water rinse completed the cleaning cycle.

Results? Oakite RUSTRIPPER had not only accomplished a cleaning job that was 95% perfect, but had reduced down-time by *six* hours, slashed cleaning costs by *$1200!*

Oakite RUSTRIPPER is also excellent for reconditioning salvaged parts, stripping paint from metal equipment, and many other heavy-duty refinery conditioning chores. RUSTRIPPER is safe, too... won't attack sound metal or give off troublesome fumes. Your local Oakite Technical Service Representative will gladly demonstrate remarkable Oakite RUSTRIPPER for you at your convenience. Call him today... no obligation. Or write Oakite Products, Inc., 44C Rector St., N. Y. 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

MATERIALS · METHODS · SERVICE

Technical Service Representatives in Principal Cities of U. S. and Canada

(To obtain more data on advertised products see page 126)

ADDED "LIFE" FOR YOUR MOTOR FUEL

that's

RETAINED VOLATILITY

Blending WARREN NATURAL GASOLINE with your present high quality motor fuel will give it the RETAINED VOLATILITY so necessary for superior performance after it reaches your customers' fuel tanks.

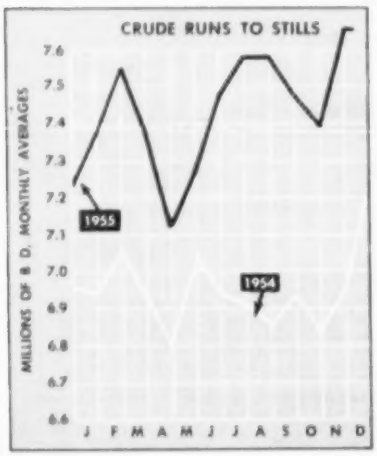
WARREN'S production, transportation, storage and service are your assurance of the quality and quantity of NATURAL GASOLINE you need . . . when and where you want it.

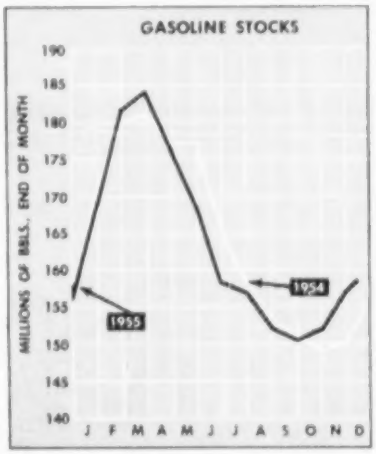
WARREN

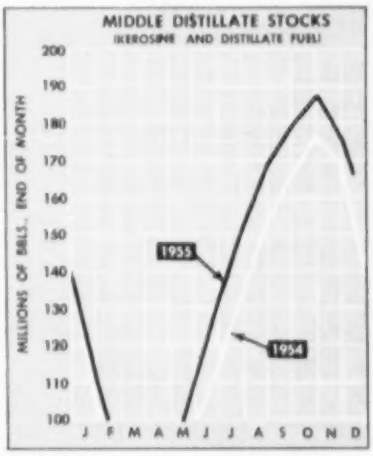
PETROLEUM CORPORATION

TULSA, OKLAHOMA • Cable Addresses: STAVOLENE, WARREN

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS, SAN PEDRO, CALIF.







1955 figures to Dec. 9

Runs High for Early Winter Needs

OUTLOOK: High crude runs will push gasoline stocks during the first quarter to over 190,000,000 bbls.

RUNS to stills jumped sharply with the first cold spell, averaging 7,655,000 b/d for the six weeks of November and early December, 9.7% higher than for the same period in 1954. Large increases took place in the combined Ind.-Ill.-Ky. and Okla.-Kans.-Mo. districts. At the present volume of runs, higher operating rates are indicated for the first quarter than the currently forecast 7,720,000 b/d avg.

Distillate fuel oil stocks are ample unless severe weather hits the East Coast and New England, and the upper Midwest states. Withdrawals for the U.S. started earlier and have been larger than last year, but total inventories Dec. 9 (134,413,000 bbls.) were still 10,346,000 bbls. (8.3%) larger than Dec. 10, 1954. Biggest pull on stocks has been in inland refining districts.

Plant output of distillate fuel oil in November was nearly 1,700,000 b/d, and higher output is indicated for December. High stock withdrawals in November shoved demand at refineries to 2,021,000 b/d, nearly 12% higher than a year ago.

Gasoline demand will continue high if the winter continues open, perhaps bringing first quarter (1956) demand to over the forecast 3,460,000 b/d avg. However, refinery supply is at a rate that is banking up stocks rapidly. Last year, refiners' inventories Dec. 10 (150,653,000 bbls.) were practically unchanged from Oct. 14. This fall they gained about 7,900,000 bbls. during the comparable weeks, and Dec. 9 were 158,374,000 bbls. The weeks of largest seasonal buildup are just ahead, and inventories will start 1956 at well over the 160,000,000 bbls. considered adequate for supply needs.

Residual fuel oil supplies may become short for some areas and some class of users. U.S. Stocks Dec. 9 (42,767,000 bbls.) were 10,000,000 bbls. less than the year before. In California, stocks this year are less than half those of last year. Refinery output is dependent both on imports and stock withdrawals to meet winter demand.

KEY STATISTICS

(Figures given in terms of millions of b/d, monthly averages, except stocks, which are in millions of bbls. at end of month)

	Dec. 1955*	Nov. 1955	Dec. 1954
CRUDE OIL			
U. S. Production	6.903	6.831	6.394
Imports	.832	.820	.729
U. S. Stocks	256.920	257.711	258.385
Runs to Still	7.658	7.664	7.238
GASOLINE			
Refinery Output	3.806	3.756	3.515
Refinery Demand	3.762	3.686	3.455
Primary Stocks	158.374	157.059	155.400
MIDDLE DISTILLATES			
Refinery Output	2.058	2.016	2.049
Refinery Demand	3.027	2.451	3.112
Primary Stocks	166.418	175.143	135.970
RESIDUALS			
Refinery Output	1.212	1.175	1.187
Imports	.462	.409	.527
Total Supply	1.674	1.584	1.714
Refinery Demand	1.857	1.642	1.820
Primary Stocks	42.767	44,410	52.105

*Through Dec. 9

PRODUCT AND CRUDE PRICES

(Products—¢ gal., weighted average prices in principal refinery markets
Crudes—$/bbl., principal fields
Source—Platt's Oilgram Price Service

	Dec. 1955*	Nov. 1955	Dec. 1954
Gasoline (regular)	11.81	11.81	11.22
Distillate Fuel Oil	9.04	8.93	9.06
Kerosine	10.44	10.35	10.56
Residuals	4.91	4.84	4.08
Above 4 Products	9.26	9.22	8.72
Lube Oils	20.41	20.28	16.46
Crude	2.83	2.83	2.81

REFINERY YIELDS

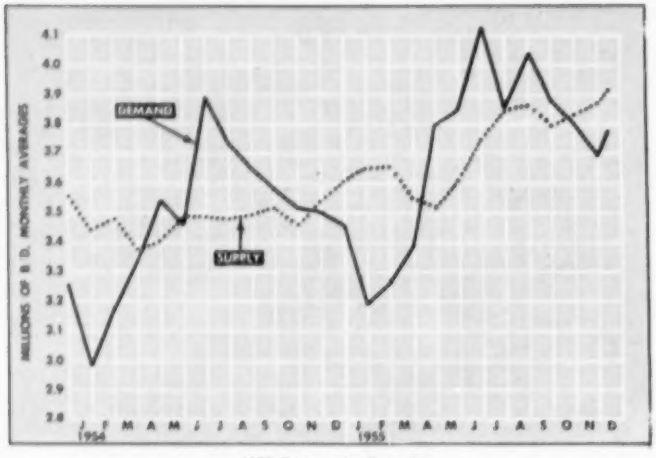
% on Crude Runs to Stills

	Dec. 1955*	Nov. 1955	Dec. 1954
Gasoline	44.5	44.4	43.8
Kerosine	4.5	4.3	4.8
Distillate	22.4	22.0	21.3
Residuals	15.8	15.3	16.4

*Through Dec. 9

SOURCE OF DATA: Oct., Nov. and Dec., API weekly reports, earlier months, Bureau of Mines

Open Early Winter Helps Motor Gasoline Demand

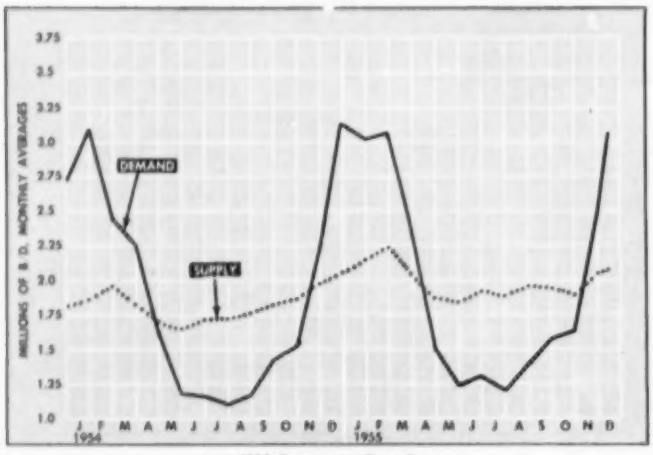


1955 figures to Dec. 9

MOTOR FUELS

	From Crude	From Nat. Gas.	Total
SUPPLY (Millions of b/d)			
Nov. '54	3.406	.450	3.856
Nov. '54	3.075	.455	3.530
Change	+ .331	− .005	+ .326
% Change	+10.1	−1.1	+9.2
DEMAND (including Exports) (Millions of b/d)			
Nov. '55			3.686
Nov. '54			3.505
Change			+ .181
% Change			+5.2
TOTAL SUPPLY (Millions of bbls.)			
11 Mos. '55	1,097.045	142.244	1,239.289
11 Mos. '54	1,016.562	140.837	1,157.399
Change	+ 80.483	+ 1.407	+ 81.890
% Change	+ 7.9	+ 1.0	+ 7.1
TOTAL DEMAND (including Exports) (Millions of bbls.)			
11 Mos. '55			1,242.613
11 Mos. '54			1,165.688
Change			+ 76.925
% Change			+ 6.6

Middle Dist. Demand Climbs to Over 3,000,000 B/D

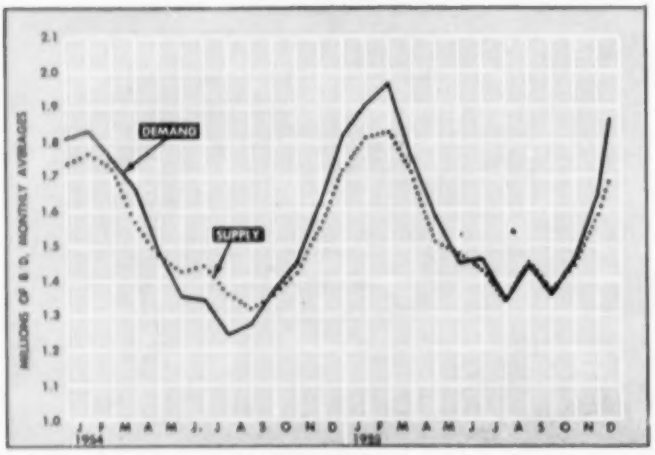


1955 figures to Dec. 9

MIDDLE DISTILLATES

	Kerosine	Dist. Fuel Oil	Total
PRODUCTION (Millions of b/d)			
Nov. '55	.333	1.683	2.016
Nov. '54	.354	1.622	1.976
Change	− .021	+ .061	+ .040
% Change	−5.9	+3.8	+2.0
DEMAND (including Exports) Millions of b/d)			
Nov. '55	.430	2.021	2.451
Nov. '54	.440	1.806	2.246
Change	− .010	+ .215	+ .205
% Change	−2.3	+11.9	+9.1
TOTAL PRODUCTION (Millions of bbls.)			
11 Mos. '55	106.467	546.989	653.456
11 Mos. '54	110.509	490.560	601.069
Change	− 4.042	+ 56.429	+ 52.387
% Change	− 3.7	+ 11.2	+ 8.7
TOTAL DEMAND (including Exports) (Millions of bbls.)			
11 Mos. '55	100.810	518.174	618.984
11 Mos. '54	104.646	474.138	578.784
Change	− 3.836	+ 44.036	+ 40.200
% Change	− 3.7	+ 9.3	+ 6.9

Sharp Spurt in Residual Fuel Oil Shipments



1955 figures to Dec. 9

RESIDUAL FUELS

	Refinery Output	Imports	Total
SUPPLY (Millions of b/d)			
Nov. '55	1.175	.409	1.584
Nov. '54	1.120	.422	1.542
Change	+ .055	− .013	+ .042
% Change	+4.9	−3.1	+2.7
DEMAND (including Exports) (Millions of b/d)			
Nov. '55			1.642
Nov. '54			1.613
Change			+ .029
% Change			+1.8
TOTAL SUPPLY (Millions of bbls.)			
11 Mos. '55	378.806	132.595	511.401
11 Mos. '54	379.951	117.060	497.011
Change	− 1.145	+ 15.535	+ 14.390
% Change	− 0.3	+ 13.3	+ 2.9
TOTAL DEMAND (including Exports) (Millions of bbls.)			
11 Mos. '55			523.622
11 Mos. '54			496.930
Change			+ 26.692
% Change			+ 5.4

SOURCE OF DATA (except prices): Oct., Nov. and Dec., API weekly reports, earlier months, Bureau of Mines

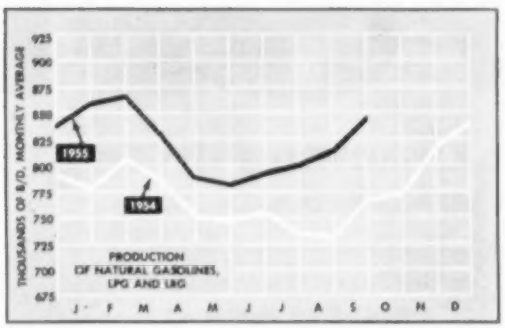
RUNS TO STILLS AND DISTRIBUTION OF PRIMARY STOCKS BY U.S. REFINERY DISTRICTS

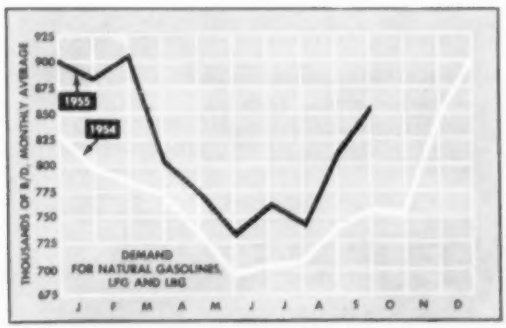
(Primary stocks include those at refineries, at large terminals and in pipelines; all data based on API reports)

District	RUNS TO STILLS (Millions of b/d average for week ending on date shown) Dec. 9 1955	Dec. 10 1954	Change	% Change	GASOLINE STOCKS (Millions of bbls., on date shown) Dec. 9 1955	Dec. 10 1954	Change	% Change	RESIDUAL STOCKS (Millions of bbls., on date shown) Dec. 9 1955	Dec. 10 1954	Change	% Change
East Coast	1.080	1.040	+ .040	+ 3.8	35.940	32.951	+2.989	+ 9.1	12.231	8.959	+ 3.272	+36.5
Gulf Coast	2.514	2.402	+ .112	+ 4.7	30.269	32.817	−2.548	− 7.8	8.431	6.144	+ 2.287	+37.2
Total Coastal	3.594	3.442	+ .152	+ 4.4	66.209	65.768	+ .441	+ 0.7	20.662	15.103	+ 5.559	+36.8
Appalachian	.204	.170	+ .034	+20.0	6.869	6.840	+ .029	+ 0.4	.941	.822	+ .119	+14.4
Ind.-Ill.-Ky.	1.415	1.288	+ .127	+ 9.9	32.527	31.314	+1.213	+ 3.8	4.232	3.851	+ .381	+ 9.9
Okla.-Kans.-Mo.	.713	.637	+ .076	+11.9	16.054	13.564	+2.490	+18.4	1.584	1.380	+ .204	+14.8
Other Inland	.614	.572	+ .042	+ 7.3	15.005	15.066	− .061	− 0.4	2.277	2.303	− .026	− 1.1
Total Inland	2.946	2.667	+ .279	+10.5	70.455	66.784	+3.671	+ 5.5	9.034	8.356	+ .678	+ 8.1
Total East of Calif.	6.540	6.109	+ .431	+ 7.1	136.664	132.552	+4.112	+ 3.1	29.696	23.459	+ 6.237	+26.6
California	1.078	.996	+ .082	+ 8.2	21.710	18.101	+3.609	+19.9	13.071	29.344	−16.273	−55.5
Total U. S.	7.618	7.105	+ .513	+ 7.2	158.374	150.653	+7.721	+ 5.1	42.767	52.803	−10.036	−19.0

District	DISTILLATE FUEL OIL STOCKS (Millions of bbls., on date shown) Dec. 9 1955	Dec. 10 1954	Change	% Change	KEROSINE STOCKS (Millions of bbls., on date shown) Dec. 9 1955	Dec. 10 1954	Change	% Change	TOTAL MIDDLE DISTILLATE STOCKS (Millions of bbls., on date shown) Dec. 9 1955	Dec. 10 1954	Change	% Change
East Coast	51.199	45.483	+ 5.716	+12.6	13.413	12.877	+ .536	+ 4.2	64.612	58.360	+ 6.252	+10.7
Gulf Coast	21.986	20.558	+ 1.428	+ 6.9	5.731	7.621	−1.890	−24.8	27.717	28.179	− .462	− 1.6
Total Coastal	73.185	66.041	+ 7.144	+10.8	19.144	20.498	−1.354	− 6.6	92.329	86.539	+ 5.790	+ 6.7
Appalachian	3.830	3.199	+ .631	+19.7	1.118	1.110	+ .008	+ 0.7	4.948	4.309	+ .639	+14.8
Ind.-Ill.-Ky.	24.357	23.148	+ 1.209	+ 5.2	7.631	8.656	−1.025	−11.8	31.988	31.804	+ .184	+ 0.6
Okla.-Kans.-Mo.	13.794	12.509	+ 1.285	+10.3	1.760	2.261	− .501	−22.2	15.554	14.770	+ .784	+ 5.3
Other Inland	7.679	6.311	+ 1.368	+21.7	1.964	1.278	+ .686	+53.7	9.643	7.589	+ 2.054	+27.1
Total Inland	49.660	45.167	+ 4.493	+ 9.9	12.473	13.305	− .832	− 6.3	62.133	58.472	+ 3.661	+ 6.3
Total East of Calif.	122.845	111.208	+11.637	+10.5	31.617	33.803	−2.186	− 6.5	154.462	145.011	+ 9.451	+ 6.5
California	11.568	12.859	− 1.291	−10.0	.388	.407	− .019	− 4.7	11.956	13.266	− 1.310	− 9.9
Total U. S.	134.413	124.067	+10.346	+ 8.3	32.005	34.210	−2.205	− 6.4	166.418	158.277	+ 8.141	+ 5.1

Natural Gas and Refinery Gas Liquids





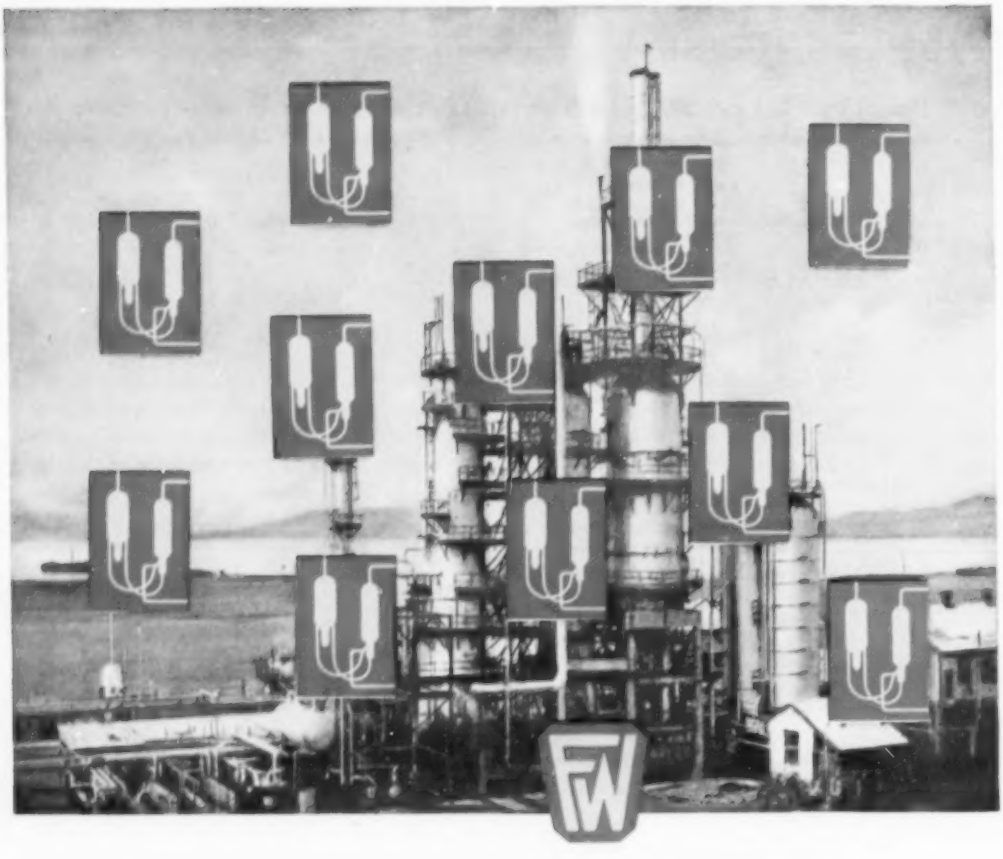
SUPPLY AND DEMAND STATISTICS

(Bureau of Mines Data)

	Sept. 1955	Aug. 1955	Sept. 1954
CURRENT PRODUCTION			
(1000 b/d monthly average			
At Natural Gasoline and Cycling Plants			
Liquefied Petroleum Gas	357	328	315
Natural Gasoline and Isopentane	287	288	273
Condensate	21	20	25
Finished Gasoline, Naphtha and other	61	63	63
Total Natural Gasoline and Cycling Plant Production	726	699	676
Liquefied Refinery Gases	122	119	89
Total Marketable Gas Liquids	848	818	765
Lease Condensate	108	104	93
Total Natural Gas Liquids	956	922	858
CURRENT DEMAND (1000 b/d monthly average)			
LPG and LRG	479	395	400
Natural Gasoline, Isopentane and Other	380	349	355
Total Marketable Gas Liquids	859	744	755

	Sept. 1955	Sept. 1954
CUMULATIVE PRODUCTION (1000 bbls.)		
LPG and LRG	125,842	111,784
Natural Gasoline, Isopentane and Other	98,455	95,941
Total Marketable Gas Liquids	224,297	207,725
CUMULATIVE DEMAND (1000 bbls.)		
LPG and LRG	121,622	106,544
Natural Gasoline, Isopentane and Other	99,180	96,079
Total Marketable Gas Liquids	220,802	202,623

	Sept. 1955	Aug. 1955	Sept. 1954
STOCKS (1000 bbls., end of month)			
LPG and LRG	11,978	11,980	9,716
Natural Gasoline, Isopentane and Other	4,401	4,728	4,751
Total Stocks	16,379	16,708	14,467



eleven

Model IV Fluid Catalytic Cracking Units... by Foster Wheeler

THE Model IV Fluid Catalytic Cracking Process, developed by The Esso Research and Engineering Company, is in operation throughout the worldwide petroleum industry. Foster Wheeler has designed and constructed Model IV plants in Canada, India, France, Australia, The Philippines and Indonesia.

This FW know-how in fluid catalytic cracking process design and construction can help you get higher octane fuels on stream faster, at lowest possible cost. We will be glad to quote on your requirements. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST CATHARINES, ONT

Petroleum Processing's *Clip-n-File* ENGINEERING DATA SHEET 1

PRESSURE—Fundamentals

DEFINITION: Pressure is the force or thrust exerted on a surface, and is normally expressed as force/unit area. Common examples are air pressure in a tire or the water pressure deep in the ocean. Since pressure is exerted in all directions within a system, it is not usually regarded as a force vector.

WHAT CAUSES IT: In gases the force is the combined beating of confined molecules, traveling their random paths. If the amount of energy associated with the molecules is altered the pressure will vary. Two ways of doing this are: (1) change the temperature (or heat content), or (2) alter the confining limits of the gas(—a volume change).

In the case of **liquid** pressure, the force is an indication of the stored potential—or the moving kinetic energy of the system. The pressure at the bottom of a tank of liquid defines the potential energy stored in the depth of liquid overhead. The pressure in a pipe of moving liquid is an indication of the kinetic energy imparted to the system—often by a pump.

RELATIONSHIP TO OTHER VARIABLES: Since pressure is an indication of the energy of a system, it is closely related to other energy variables. In gases it's closely related to temperature; in liquids it varies with velocity or liquid level. Since gases are compressible and liquids are not (by comparison), different formulas express these relationships:

For gases: $PV/T =$ Constant

$P =$ Pressure $V =$ Volume $T =$ Temperature

For liquids:

$P = wh$ and $h = v^2/2g$

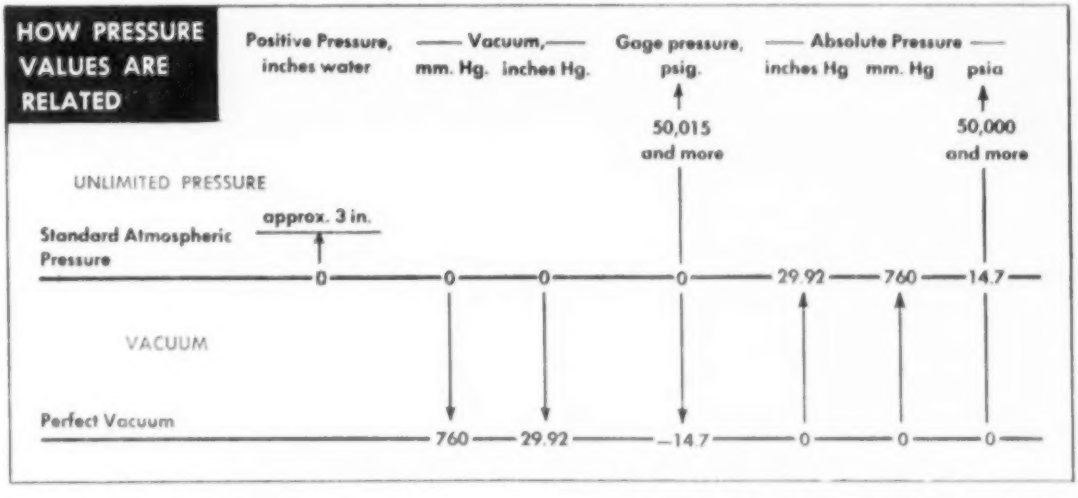
$P =$ Pressure $w =$ specific weight $v =$ velocity

$h =$ liquid depth $g = 32$ ft./sec., (acceleration due to gravity)

HOW IT IS MEASURED: Since pressure is a force (per unit area) it may be measured by balancing it against a known force, or by measuring its effect on a related variable, such as temperature or conductivity.

Direct Methods: In balancing the unknown pressure directly against a known force several devices may be used. Spring elements, such as a Bourdon tube, bellows, or diaphragm; a weight-loaded piston; or a visual liquid column in a manometer.

Inferential Methods. These methods rely on known relationships between pressure and temperature or electrical conductivity. In a Pirani gage it is the thermal conductivity of the material that is measured; in a pressure-cell it is the change in electrical resistance of a wire strained by pressure. And a piezo-electrical crystal will produce an electrical charge that varies with pressure.



UNITS OF MEASUREMENT: Although a perfect vacuum cannot exist on the surface of the earth, nevertheless it makes a convenient datum for the measurement of pressure. Barometric pressure is the level of atmospheric pressure above perfect vacuum. "Standard" atmospheric pressure is 14.697 psi, or 760 mm of mercury. Gauge pressure is measured above atmospheric; absolute pressure is measured above perfect vacuum. A vacuum—usually expressed as inches of mercury—is the depression of pressure below the atmospheric level. Small pressures above atmospheric are expressed as inches of water.

The pressures encountered in industry vary from ultrahigh vacuums of less than 1 micron (1 thousandth of a mm) of Hg absolute to as high as 50,000 psi or higher.

For More Data, Turn the Page . . .

Pressure Equivalents

Pounds per Square Inch	Kilograms per sq. cm. (Metric atmospheres)	Atmospheres	Columns of Mercury 32° F.		Columns of Water at 60° F.		
			Inches	Meters	Inches	Feet	Meters
1	.0703067	.06804	2.03589	.0517116	27.6798	2.30665	.70305
14.2234	1	.96777	28.9570	.73550	393.6996	32.8083	10.000
14.697	1.0333	1	29.9212	.760	406.808	33.9007	10.333
491149	.0345349	.03342	1	.02540	13.596	1.133	.34534
19.3381	1.3595	1.31575	39.37	1	535.27	44.6406	13.595
.03613	.002540	.002458	.07355	.001868	1	.08333	.0254
433530	.0304801	.0294979	.882612	.2240	12	1	.3048
1.4223	.1	.09677	2.8937	.07355	39.37	3.2810	1

Barometric Pressures

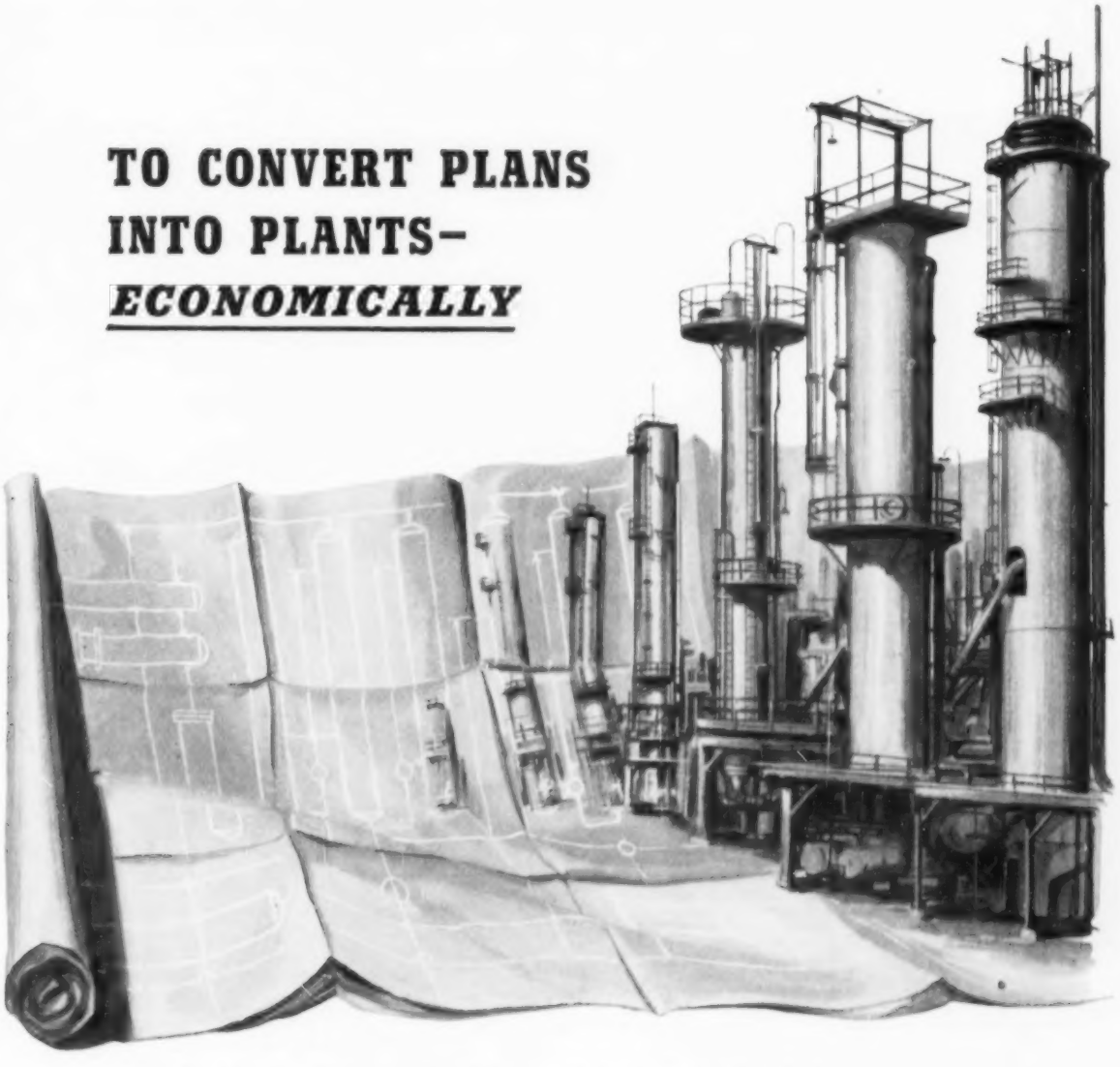
Barometer reading in inches multiplied by 0.4908 equals pressure per square inch.

Altitude	Barometric Pressure	Equivalent Head of Water	Maximum Suction Lift of Pumps
Sea Level	14.70 lbs. per sq. in.	33.95 feet	25 feet
¼ mile (1320 ft.) above sea level	14.02 " "	32.38 "	24 "
½ " (2640 ") " "	13.33 " "	30.79 "	23 "
¾ " (3960 ") " "	12.66 " "	29.24 "	21 "
1 " (5280 ") " "	12.02 " "	27.76 "	20 "
1¼ " (6600 ") " "	11.42 " "	26.38 "	19 "
1½ " (7920 ") " "	10.88 " "	25.13 "	18 "
2 " (10560 ") " "	9.88 " "	22.82 "	17 "

Water Head in Feet and Equivalent Pressure in Pounds per Square Inch

Head in Feet	Equival't Pressure in Pounds per sq. in.	Head in Feet	Equival't Pressure in Pounds per sq. in.	Head in Feet	Equival't Pressure in Pounds per sq. in.	Head in Feet	Equival't Pressure in Pounds per sq. in.	Head in Feet	Equival't Pressure in Pounds per sq. in.	Head in Feet	Equival't Pressure in Pounds per sq. in.
1	0.43	51	22.09	101	43.75	151	65.40	225	97.43	1475	638.68
2	0.86	52	22.52	102	44.18	152	65.84	250	108.25	1500	649.50
3	1.30	53	22.95	103	44.61	153	66.27	275	119.08	1525	660.33
4	1.73	54	23.39	104	45.05	154	66.70	300	129.90	1550	671.15
5	2.16	55	23.82	105	45.48	155	67.14	325	140.73	1575	681.98
6	2.59	56	24.26	106	45.91	156	67.57	350	151.55	1600	692.80
7	3.03	57	24.69	107	46.34	157	68.00	375	162.38	1625	703.63
8	3.46	58	25.12	108	46.78	158	68.43	400	173.20	1650	714.45
9	3.89	59	25.55	109	47.21	159	68.87	425	184.03	1675	725.28
10	4.33	60	25.99	110	47.64	160	69.31	450	194.85	1700	736.10
11	4.76	61	26.42	111	48.08	161	69.74	475	205.68	1725	746.93
12	5.20	62	26.85	112	48.51	162	70.17	500	216.50	1750	757.75
13	5.63	63	27.29	113	48.94	163	70.61	525	227.33	1775	768.58
14	6.06	64	27.72	114	49.38	164	71.04	550	238.15	1800	779.40
15	6.49	65	28.15	115	49.81	165	71.47	575	248.98	1825	790.23
16	6.93	66	28.58	116	50.24	166	71.91	600	259.80	1850	801.05
17	7.36	67	29.02	117	50.68	167	72.34	625	270.63	1875	811.88
18	7.79	68	29.45	118	51.11	168	72.77	650	281.45	1900	822.70
19	8.22	69	29.88	119	51.54	169	73.20	675	292.28	1925	833.53
20	8.66	70	30.32	120	51.98	170	73.64	700	303.10	1950	844.35
21	9.09	71	30.75	121	52.41	171	74.07	725	313.93	1975	855.18
22	9.53	72	31.18	122	52.84	172	74.50	750	324.75	2000	866.00
23	9.96	73	31.62	123	53.28	173	74.94	775	335.58	2025	876.83
24	10.39	74	32.05	124	53.71	174	75.37	800	346.40	2050	887.65
25	10.82	75	32.48	125	54.15	175	75.80	825	357.23	2075	898.48
26	11.26	76	32.92	126	54.58	175	76.23	850	368.05	2100	909.30
27	11.69	77	33.35	127	55.01	177	76.67	875	378.88	2125	920.13
28	12.12	78	33.78	128	55.44	178	77.10	900	389.70	2150	930.95
29	12.55	79	34.21	129	55.88	179	77.53	925	400.53	2175	941.78
30	12.99	80	34.65	130	56.31	180	77.97	950	411.35	2200	952.60
31	13.42	81	35.08	131	56.74	181	78.40	975	422.18	2225	963.43
32	13.86	82	35.52	132	57.18	182	78.84	1000	433.00	2250	974.25
33	14.29	83	35.95	133	57.61	183	79.27	1025	443.83	2275	985.08
34	14.72	84	36.39	134	58.04	184	79.70	1050	454.65	2300	995.90
35	15.16	85	36.82	135	58.48	185	80.14	1075	465.48	2325	1006.73
36	15.59	86	37.25	136	58.91	186	80.57	1100	476.30	2350	1017.55
37	16.02	87	37.68	137	59.34	187	81.00	1125	487.13	2375	1028.38
38	16.45	88	38.12	138	59.77	188	81.43	1150	497.95	2400	1039.20
39	16.89	89	38.55	139	60.21	189	81.87	1175	508.78	2425	1050.03
40	17.32	90	38.98	140	60.64	190	82.30	1200	519.60	2450	1060.85
41	17.75	91	39.42	141	61.07	191	82.73	1225	530.43	2475	1071.68
42	18.19	92	39.85	142	61.51	192	83.17	1250	541.25	2500	1082.50
43	18.62	93	40.28	143	61.94	193	83.60	1275	552.08	2525	1093.33
44	19.05	94	40.72	144	62.37	194	84.03	1300	562.90	2550	1104.15
45	19.49	95	41.15	145	62.81	195	84.47	1325	573.73	2575	1114.98
46	19.92	96	41.58	146	63.24	196	84.90	1350	584.55	2600	1125.80
47	20.35	97	42.01	147	63.67	197	85.33	1375	595.38	2625	1136.63
48	20.79	98	42.45	148	64.10	198	85.76	1400	606.20	2650	1147.45
49	21.22	99	42.88	148	64.54	199	86.20	1425	617.03	2675	1158.28
50	21.65	100	43.31	150	64.97	200	86.60	1450	627.85	2700	1169.10

TO CONVERT PLANS INTO PLANTS— *ECONOMICALLY*



• Deal with an organization which knows that processing time lost can be counted as dollars wasted.

• Deal with people who have flourished in the limelight of completion promises made—and kept.

• Deal with a company which builds its reputation by building yours.

• For economical construction in chemical, petrochemical, and refinery processing, look to:

PROCON *Incorporated*

1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS, U. S. A.

PROCON *(Canada)* LIMITED

40 ADVANCE ROAD, TORONTO 18, ONTARIO

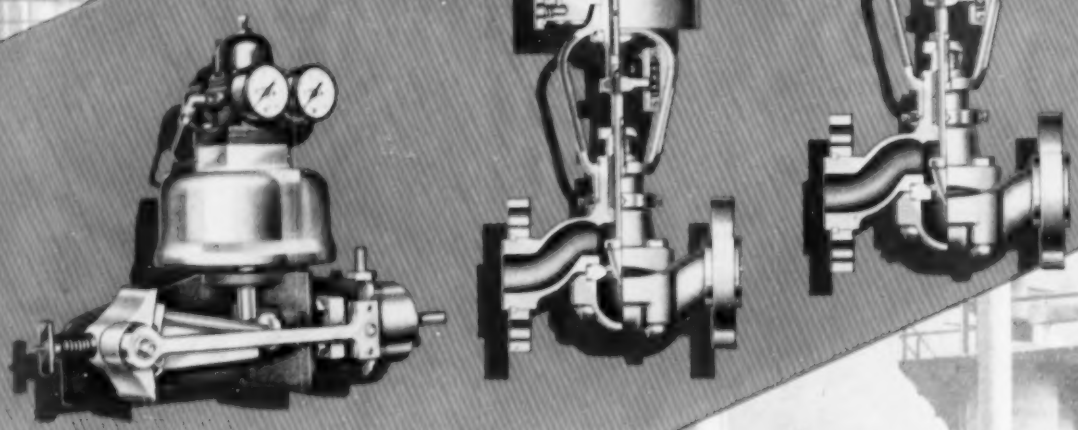
PROCON *(Great Britain)* LIMITED

BUSH HOUSE, ALDWYCH, LONDON, W. C. 2.

PROCON®

WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

Reward your process
WITH THE BEST IN CONTROL VALVES



FOR BETTER CONTROL

You reward your process with the best in control valves when you call for Annin Domotor Control Valves, specified by engineers responsible for the most advanced processes throughout the world. Domotor control valves are no longer new, but they are still the most advanced fluid control valves available anywhere. Whether your primary problem is control accuracy, tight closure, hi-resistance to erosion and corrosion, wide rangeability or low maintenance, you, too, should insist on Domotor Control Valves, produced by The Annin Company, oldest manufacturer of valves DESIGNED for modern automatic control.

Write now for your copy of Annin's new catalog on valves for fluid control

ANNIN Control VALVES

THE ANNIN COMPANY
6570 EAST TELEGRAPH ROAD, LOS ANGELES 22, CALIFORNIA

Curtis M. Klaerner has been named assistant general manager of operations in Socony Mobil Oil Co.'s headquarters manufacturing department. As manager of the Buffalo refinery he has been succeeded by **T. C. Lockhart,** formerly manager of the light oil operations division in Socony's New York manufacturing department.

After his graduation in 1942 from the University of Texas with a B.S. in chemical engineering, Klaerner joined Magnolia Petroleum Co. He became Buffalo refinery manager in 1954.

Lockhart came to the U. S. from his native Ireland in 1915. He received a B.S. in chemical engineering at Drexel Institute of Technology in 1935. In 1953 he was appointed manager of the light oil operations division.

James P. Shambaugh has been promoted to manager of the process promotion division in the manufacturing department. He had been assistant manager of the division since 1952 and succeeds **Arthur V. Danner,** who has become a director and vice-president of Mobil Overseas Oil Co.

A 1935 graduate in chemical engineering of the University of Illinois, Shambaugh joined Socony in 1939 in the research and development laboratories at Paulsboro. Here he helped develop Socony's Thermofor Catalytic Cracking process.

David P. Thornton, Jr., Southwestern editor of PETROLEUM PROCESSING, has joined the staff of Universal Oil Products Co. as technical assistant to the director of public relations.

Mr. Thornton

Thornton has been with publications serving the petroleum industry for the last 15 years. He joined the former W. C. Platt organizations in 1940 as a market reporter for **Platt's Oilgram.**

Two years later Thornton was made manager of the Tulsa, Okla., office of the *Oilgram* and of *National Petroleum News.* Here he remained until the Tulsa office was closed in 1950, when he moved to Houston.

From 1942 to 1946 Thornton also served as an assistant editor of what was known as the Technical Section of *National Petroleum News.* When this was made a separate publication and named PETROLEUM PROCESSING, Thornton became its Southwestern editor. He remained in the position after McGraw-Hill Publishing Co. purchased the Platt properties.

He was graduated from Oklahoma A.&M. College in 1936 with a B.S. in chemical engineering.

CITED FOR SERVICE to the American Petroleum Institute, Dr. Howard G. Vesper, left, vice-president of Standard Oil Co. of California, receives his merit award from Dr. Robert E. Wilson, Standard Oil Co. (Ind.) and API director. Award noted Vesper's services as chairman and member of the advisory committee on fundamental research on petroleum composition and properties.

R. Wolcott Hooker, vice-president of Hooker Electrochemical Co., has been elected president of the Synthetic Organic Chemical Manufacturers Assn. He succeeds Dr. Samuel Lenher, of Du Pont Co.

Hooker began with Hooker Electrochemical as a salesman in 1922. He became sales manager in 1935 and a director of the company two years later. He was named vice-president of sales in 1941, and vice-president responsible for purchasing policies and public relations in 1953.

Neil B. Conley, American Cyanamid Co. and **James A. Singmaster,** Monsanto Chemical Co., were elected to the board of governors.

David J. Stark has been elected vice-president of Escambia Bay Chemical Corp. He is the company's plant manager, responsible for construction and operation of the petrochemical plant currently under construction at Pensacola, Fla.

He joined Escambia Bay early in 1955, having served before this as manager of the National Petrochemicals Corp. plant at Tuscola, Ill. Prior to that he was chief technologist and department manager of catalytic cracking for Shell Oil Co. at the Montreal, Can., plant.

Dr. Nat C. Robertson has become Escambia's director of research. He was director of the petrochemical department of National Research Corp. for several years. Robertson was with the former Standard Oil Development during World War II, and from 1947 to 1951 he was in charge of a physical chemistry research group at Celanese Corp. of America.

Jan G. Schaafsma has been made manager of the laboratories department of General Petroleum Corp. He began with the company in 1934 upon receiving an M.S. degree in chemical engineering from the California Institute of Technology. He became assistant manager of the labs in 1954 and had been acting manager for the past six months.

R. W. Ballmer has become yard process superintendent of Standard Oil of Ohio's No. 1 refinery in Cleveland. He succeeds **Napier J. Box,** who has retired and moved to Florida after 44 years with Sohio.

J. G. Boerwinkle replaces Ballmer as distillation foreman. And **L. E. Sliter** takes Boerwinkle's post, hill shift foreman.

A new position of asphalt superintendent has been given to **Saunders**

Kornhauser, and he has been succeeded as asphalt foreman by **C. W. Davis. E. D. Wells** has become asphalt emulsion foreman.

Ballmer, a chemical engineer from Michigan State University, has been with Sohio since 1946. Boerwinkle joined the company as a laborer in 1931, the same year that Sliter began with Sohio as a pipefitter helper. Kornhauser is a chemical engineer from Case Institute of Technology and began with Sohio as an asphalt tester in 1931. Davis has been with the company since 1931, Wells since 1941.

John C. Denton has been appointed vice-president and general works manager of the Spencer Chemical Co. He was formerly general manager of engineering and construction for the company. He replaces **Richard F. Brown,** who has resigned to work for a company in the nitrogen business. Denton is a graduate of Tulsa University with a degree in petroleum engineering. He has been with Spencer since 1942.

Denton's post has been given to **Byron Kern,** who was chief engineer of the company. **Robert Byorum,** formerly assistant chief engineer, has been moved up to chief engineer. Kern is a graduate in chemical engineering of the University of Kansas. He joined the company in 1946 and became chief engineer in 1953.

Byorum, a chemical engineer from the University of Oklahoma, began with Spencer in 1948.

Vladimir A. Kalichevsky, consulting chemical engineer of the Magnolia Petroleum Co., has been given the 1955 Southwest Award of the American Chemical Society. An annual award for exceptional achievement by a chemist or chemical engineer of the Southwest, the citation notes his role in originating and developing the Thermofor Catalytic Cracking, continuous wax molding, and the Dualayer gasoline and distillate treating processes. The award consists of a bronze plaque and cash prize of $300.

Kalichevsky is a native of Tiflis, in the Russian Caucasus mountains, and he entered the U. S. in 1921 at the age of 26. He received a B.S. degree in chemical engineering in 1924 from the California Institute of Technology, and joined Union Oil Co. as a research chemist. In 1929 he moved to what is now Esso Research and Engineering Co., remaining until 1931, when he was employed by what is now Socony Mobil Oil Co. In 1937 he became general supervisor of the research and development department.

He took his present post with Magnolia in 1944.

Mr. Davis

Mr. McOmie

Mr. Goldsmith

Mr. Barton

C. E. Davis, Shell Oil Co. vice-president in charge of refining, has retired after 38 years with the company. He will become a petroleum consultant and serve part-time as general secretary of the Fifth World Petroleum Congress, which will convene in the U. S. in 1959.

Two new posts have been created, reflecting the enlargement of the duties formerly given to the refining vice-president. The first, general manager of refineries, has been assigned to **R. W. McOmie,** who was manager of Shell's Anacortes, Wash., refinery. The other, general manager of technical departments, has been assumed by **L. R. Goldsmith,** formerly manager of manufacturing.

The manager's post at Anacortes has been given to **R. C. Barton,** previously the refinery's superintendent. The new superintendent is **J. B. Wyman,** who was assistant manager of Shell's New York manufacturing operations department.

Davis joined Shell in 1917, served in refineries in the Midwest and was made assistant to the manager of the manufacturing operations department in St. Louis in 1932. In 1938 he became assistant to the vice-president in charge of manufacturing, and in 1943 he took the post of general manager of manufacturing.

His next promotion was to manufacturing vice-president for Shell's east-of-the-Rockies territory in 1945. He took his last post four years later, when Shell consolidated its nationwide activities.

McOmie began with Shell in 1927 as a chemist at the Martinez, Calif., refinery. Several posts in the company's West Coast refineries followed, and he was named the Wilmington refinery's assistant manager in 1943. He became manager there three years later and remained in that position until his assignment to Anacortes early in 1954.

Barton has been with Shell since 1934, first as a chemist and later in various operating and technical positions. In 1949 he was appointed superintendent of the Martinez refinery, where he remained until his assignment to Anacortes in the early part of 1955.

John A. Nevison has become head of the licensing section, research and development department, of the Atlantic Refining Co. He has succeeded **Byron E. Milner,** who has been made technical assistant to the vice-president and general manager of the manufacturing department.

Nevison had been assistant head of the section since its organization in 1952. This post has now been taken by **James H. McCullough,** who has been engaged in process development and plant experimental work in the department.

The following have been added to the general committee of the American Petroleum Institute's Division of Refining:

Earl Baldridge, Champlin Refining Co.; **F. G. Bannerot, Jr.,** Elk Refining Co.; **B. K. Brown,** Pan-Am Southern Corp.; **V. B. Chance,** Atlas Processing Co.

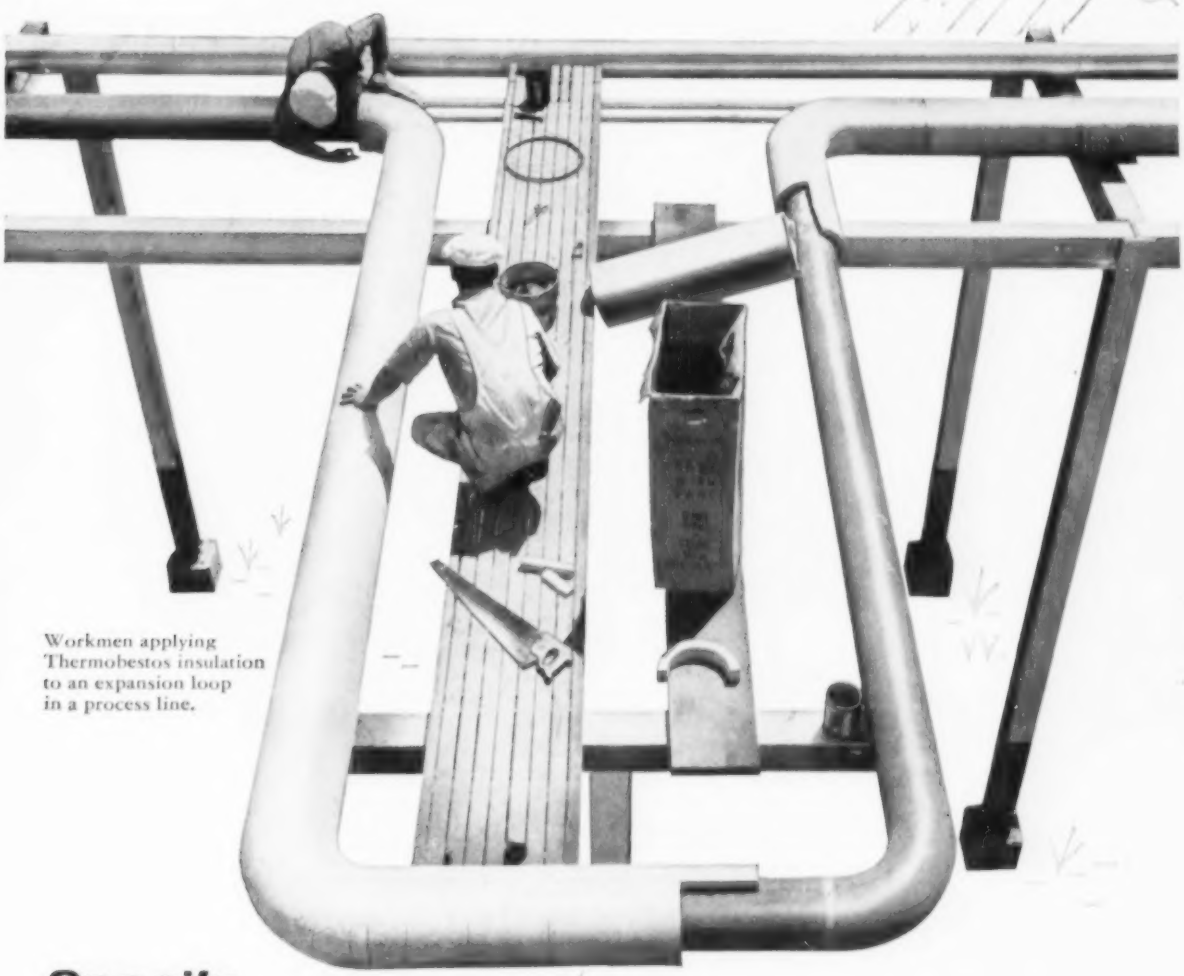
F. S. Clulow, Shell Oil Co.; **G. Davidson,** Shell Oil Co. of Canada Ltd.; **E. E. Lyder,** United States Oil & Refining Co.; **J. L. Sewell,** Delhi-Taylor Oil Corp.

Edwin Singer, Pontiac Refining Corp.; **K. W. Shimeall,** Crown Central Petroleum Corp.; **H. V. Smith,** Kendall Refining Co.

In addition, four members of the API Board of Directors have been appointed to the general committee. They are:

J. F. Daley, Du Pont Co.; **Reid Brazell,** Leonard Refineries; **Guy Hunter,** Quaker State Oil Refining Corp.; and **Glenn Nielsen,** Husky Oil Co.

When you're fighting the weather as well as heat loss



Workmen applying Thermobestos insulation to an expansion loop in a process line.

Specify

J-M THERMOBESTOS® the heat insulation designed for outdoor process industries

Here's proof that rugged physical strength and high insulating efficiency can be combined in one material. J-M Thermobestos is strong and rigid, yet light enough for easy handling and fast application. It is not damaged by prolonged wetting. Its hard composition resists crushing and will withstand unusual service abuse. The low conductivity compares favorably with other accepted industrial insulations.

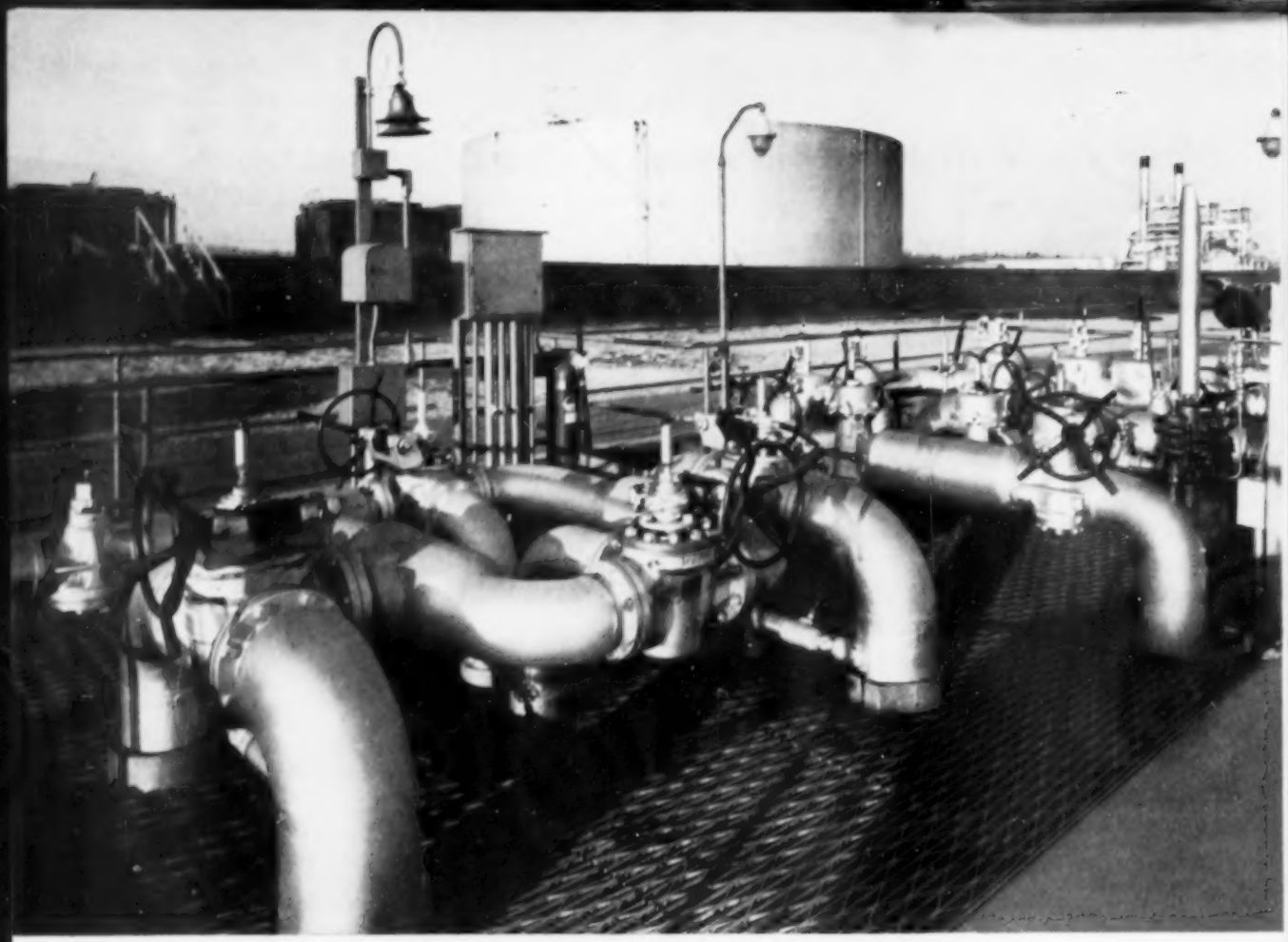
This unique combination of properties means excellent temperature control and minimum maintenance cost for oil refineries, chemical processing plants and other plants with outdoor vessels and hot piping.

Made from calcium hydrosilicate, Thermobestos is molded to size for proper fit. Its high strength makes it particularly adaptable for time-saving shop prefabrication of fittings and bends. Furnished in large sections, Thermobestos is easy to apply. It reduces the number of joints. In pipe insulation form, it comes in a complete selection of sizes up to 24" x 3" half-sections. Also available in 6" x 36" and 12" x 36" blocks in a full range of thicknesses. For further information write to Johns-Manville, Box 60, New York 16, N.Y. In Canada, Port Credit, Ontario.

JM PRODUCTS

Johns-Manville *first in* **INSULATION**

MATERIALS · ENGINEERING · APPLICATION



flow control at its best

with trouble free, economical **ROCKWELL**-Nordstrom **VALVES**

For *any* petroleum processing operation from tank farm manifolds like the one shown above to every processing-refining operation, Rockwell-Nordstrom valves assure safe, economical, dependable operation. The key to Rockwell-Nordstrom's forty years of leadership throughout the petroleum industry is *pressurized lubrication*. The unique Sealdport* system of grooves on the tapered plug and body carry pressurized lubricant that assures truly leakproof sealing and positive shut-off on lightest hydrocarbon gases or heavy crudes. Pressurized lubricant also hydraulically seats the plug for instant, quarter-turn operation. Because metal-to-metal friction is eliminated by lubrication, costly maintenance and down time are prevented.

Rockwell-Nordstrom, the *original* lubricated plug valve, is available in semi-steel, steel, stainless and corrosion resisting metals in sizes up to 30″ x 36″ for every petroleum processing requirement. For more data, contact any leading distributor or write: Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.

Canadian Valve Licensee: Peacock Brothers Limited

*Registered Trade Mark, Rockwell Manufacturing Company

ROCKWELL-Nordstrom **VALVES**

Lubricant Sealed for Positive Shut-off

40th Year *of lubricated plug valve leadership*

Do You Know These Words?

By B. H. WEIL
Manager, Information Services
Ethyl Corp. Res. & Engrg. Dept.
Detroit, Mich.

A regular department intended to help administrators and operating men alike keep abreast of technical names and processes in the petrochemical field.

Methyl Mercaptan

Methyl mercaptan, pronounced "**meth**-ihl mer-**kap**-tan," is a new petrochemical which is already in large-scale production for one use (methionine synthesis, see PETROLEUM PROCESSING, Nov., 1953, p. 1728) and which is also finding other potentially important applications. It has the formula CH_3SH (a mercaptan is like an alcohol, except that its -SH radical has a sulfur atom instead of oxygen), and is a gas at room temperature (boiling point, 46°F).

As mentioned, methyl mercaptan has until recently found only one major application—use in the synthesis of methionine, a poultry and animal feed supplement (protein) of rapidly growing importance. Production of the latter has been expanding so fast that supplies of methyl mercaptan from natural sources (separation from petroleum naphtha extracts) have proved insufficient, and several plants have been constructed to produce it by petrochemical synthesis.

One company, at least, is synthesizing methyl mercaptan by the catalytic reaction of methanol (CH_3OH) with hydrogen sulfide (H_2S). Both of these are petrochemicals, the first being synthesized from methane (natural gas) and the latter being a refinery by-product (from desulfurizing processes). Other processes (perhaps not in commercial use) involve the reaction of methyl chloride with sodium hydrosulfide, or the reaction of dimethyl sulfate with sodium (or other alkali) hydrosulfides.

Recently, methyl mercaptan has been mentioned as being of interest for use in plastics, perhaps in connection with polyethylene, and as an intermediate for jet-fuel additives and fungicides. Thus, while the synthesis of methionine will probably continue to dominate the market for methyl mercaptan for the predictable future, other uses may require considerable amounts.

Ethanol

Ethanol, pronounced "**eth**-ah-knoll," is the best known of the alcohols (organic compounds containing -OH groups), as may be recognized from some of its synonyms—grain alcohol, fermentation alcohol, spirits of wine, etc. Also called "ethyl alcohol," it is the "intoxicating principle in fermented and distilled liquors," and is also in itself an important industrial chemical—indeed, a petrochemical, for over 75% of present production is based on petroleum-derived ethylene.

Ethanol is a colorless, flammable liquid of characteristic odor and pungent taste (!), with the formula CH_3CH_2OH. Chief industrial uses are the manufacture of chemicals, drugs, coatings, and plastics, and employment as a solvent and extraction medium. The chemical uses predominate, and among these the synthesis of acetaldehyde currently takes the lion's share of production (nearly 50% of total ethanol output). Acetaldehyde itself has been described in an earlier installment in this series (Dec., 1954, p. 1897).

As a petrochemical, ethanol is produced largely by the reaction of ethylene with sulfuric acid, followed by hydrolysis (reaction with water) of the resulting ethyl sulfates. Substantial quantities are also produced by the direct catalytic hydration (also a reaction with water) of ethylene. The Synthine (Fischer-Tropsch) process based on natural gas or coal may also soon be a source of (initially small) supplies of ethyl alcohol. As regards ethylene, this petroleum-derived intermediate is a constituent of refinery cracked gases or is produced from propane, ethane, or other refinery products.

Possibilities for use of ethanol as a gasoline substitute ("power alcohol") seem at present unlikely, and in any event would chiefly affect its production from agricultural materials. Future large-scale growth of markets for industrial alcohol (ethanol) therefore seem to depend largely upon the economics (and/or expediency) of again using it for the production of butadiene (for GR-S synthetic rubber); if ethanol prices remain low, this may become attractive.

NEWS in VIEWS

PIPING POINTS TO combination processing unit at Iraq Government's new 24,000 b/d refinery near Baghdad. Unit integrates five major refining operations. For complete story, see pg. 58

TEXAS BUILDS 'EM BIG. This 48-in. gate valve is going into a new 10-million gal./day water line from Lake Houston to Shell Oil's refinery and Phillips Chemical's plant in Houston, Texas

It's definitely to your advantage to use Du Pont additives and services

The use of additives is becoming increasingly important in the petroleum industry. For this reason, additives "know-how" is also increasingly important.

This know-how (available to you through Du Pont) can give you specific and valuable manufacturing, sales and economic advantages which are not readily available except through an organization with broad research and manufacturing facilities.

A complete line of additives

Du Pont offers a complete line of gasoline additives. Not only do we supply tetraethyl lead, gasoline dyes, antioxidants, and Metal Deactivator, but our line also includes heating and diesel oil additives, lube oil additives and grease stabilizers together with the services that go with all of them.

To make sure that each additive does its job in a variety of individual refining operations, Du Pont provides five regional laboratories—working exclusively on refiners' additives and quality problems. What's more, these laboratories—like the Du Pont warehousing and shipping points—are conveniently located right in the five major refining areas of the country.

An interior view of a typical Du Pont Petroleum Chemicals Division regional laboratory. It is completely staffed and equipped to handle practically all types of additives problems.

Marketing services, too

As you know, the use of additives can enhance your sales opportunities . . . give you a strong competitive wedge. Since Du Pont supplies the widest range of additives, this company also offers you the widest range of marketing aids . . . for your lube oils, heating oils, diesel fuels and greases—as well as several outstanding programs for gasoline. And all of the Du Pont marketing tools are so designed that they can be easily tailored to your own individual requirements.

To take advantage of the economies and benefits that go with buying additives in bulk, just get in touch with any of the Du Pont Petroleum Chemicals Division representatives or the nearest sales office listed below.

DU PONT

REG. U.S. PAT. OFF.

Better Things for Better Living . . . through Chemistry

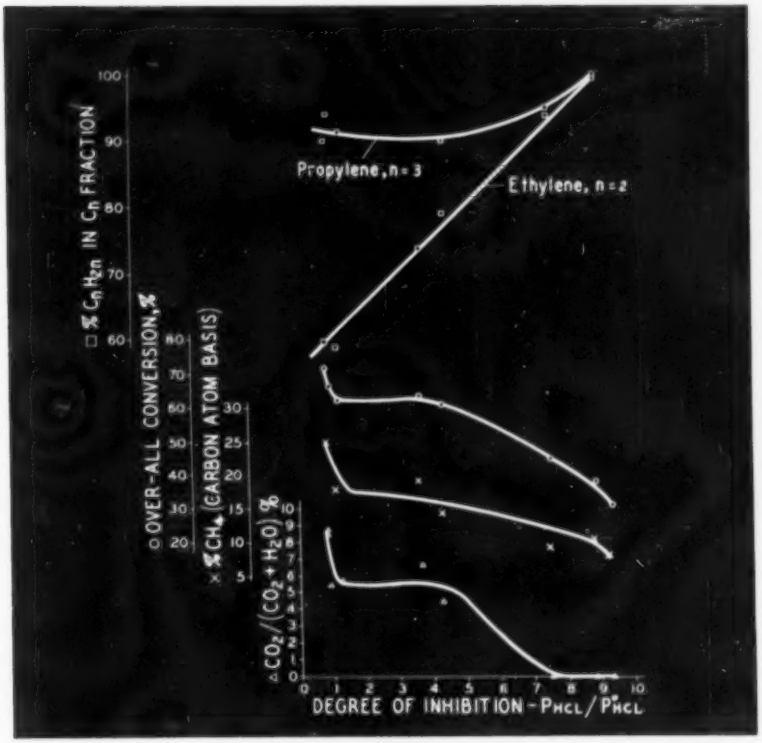
Petroleum Chemicals

Sales Offices: **E. I. DU PONT DE NEMOURS & COMPANY (INC.)** • *Petroleum Chemicals Division* • *Wilmington 98, Delaware*

CHICAGO, ILL.—8 So. Michigan Ave. . . . . Phone RAndolph 6-8630
HOUSTON, TEXAS—705 Bank of Commerce Bldg. . Phone CApitol 5-1151
LOS ANGELES, CAL.—612 So. Flower St. . . . . Phone MAdison 5-1691
NEW YORK, N. Y.—1270 Ave. of the Americas . . Phone COlumbus 5-2342
PHILADELPHIA, PA.—3 Penn Center Plaza . . . . . Phone LOcust 8-3531
PITTSBURGH, PA.—Room 510, Alcoa Bldg. . . . . Phone ATlantic 1-2933
SAN FRANCISCO, CAL.—Room 626, 111 Sutter St., Phone EXbrook 2-6230
SEATTLE, WASH.—Room 215, 4003 Aurora Ave. . . . Phone MElrose 6977
TULSA, OKLA.—P. O. Box 730 . . . . . Phone LUther 5-5578

IN CANADA: Du Pont Company of Canada Limited—Petroleum Chemicals Division—80 Richmond Street West—Toronto 1, Ontario
OTHER COUNRIES: Petroleum Chemicals Export—Nemours Bldg., 6539—Wilmington 98, Delaware

By Peter J. Gaylor, Patent Attorney, Elizabeth, N. J.



HOW CATALYST INHIBITION affects olefin, methane and CO_2 formation, and the conversion of CO plus hydrogen to hydrocarbons. See text for details

Inhibited Catalyst Said to Produce More Olefin Gases in Synthesis

THE production of hydrocarbons by catalytic reduction of carbon monoxide with hydrogen now is a well-developed and established process. Most of the emphasis has been placed on the production of liquid hydrocarbons in the gasoline range. However, the reaction possesses interest in the petrochemical field as a source of reactive gaseous hydrocarbons in the production of aliphatic chemical. In U. S. Patent No. 2,717,-259, Union Carbide & Carbon Corp. describes a process for regulating an iron catalyst with halogen to increase the proportion of unsaturated hydrocarbons in the C_2-C_4 range.

Preliminary studies with a fixed-bed iron catalyst disclosed that the usual variables—temperature, pressure, reactant ratio, rate of flow, etc.—had no important effect on the amount of C_2-C_4 fraction formed. For instance, the yield of the C_2-C_4 fraction on a carbon atom basis remained fairly constant over a temperature range of 220°-320°C. at about 25-40% of the hydrocarbons formed. It was noted, however, that the concentration of the liquid fraction (C_5 plus) did increase with increasing temperature, but was accomplished by a corresponding increase in methane formation.

The patent discloses that a radical redistribution of the hydrocarbons formed in the catalytic reduction of carbon monoxide with hydrogen can be accomplished by selective inhibition of an iron base catalyst. This will increase the formation of olefins containing from two to four carbon atoms and decrease the formation of carbon dioxide. Inhibition of the catalyst during synthesis is effected by including in the reaction system the halogens—chlorine, bromine or iodine—or the corresponding hydrogen halides. The halogens or hydrogen halides may be introduced themselves, or compounds capable of yielding them under reaction conditions may be introduced to the reaction system. The latter group includes the organic compounds of chlorine, bromine and iodine. These organic halides decompose under the reaction conditions. Fluorine and the fluorides are excluded because experiments have shown that they are not effective inhibitors.

When synthesis gas composed of carbon monoxide and hydrogen is passed over a halide-inhibited iron-base catalyst at reaction temperatures of 200° to 450°C., the C_2-C_4 fraction usually constitutes about half of the hydrocarbons formed. The olefin content of this C_2-C_4 fraction is approximately twice the olefin content of C_2-C_4 fractions formed from uninhibited catalysts after steady operating conditions have been obtained.

The effect of selective inhibition of iron-base catalysts on the product distribution at reaction temperature in the range of 220° to 320°C. is seen below.

Distribution of Hydrocarbons (on carbon atom basis)

	Untreated catalyst	Inhibited catalyst
	%	%
CH_4	10-30	10-25
C_2-C_4 olefins	10-20	25-45
C_2-C_4 paraffins	10-30	10-25
C_5 and higher	30-60	20-50
Total C_2-C_4 fraction	25-40	40-65

It will be noted that the olefin content of the C_2-C_4 fraction produced with inhibited catalysts is markedly increased. It has also been determined that the olefin content of the liquid fraction produced with inhibited catalysts is likewise quite high.

Inhibition of the catalyst also greatly reduces the amount of carbon dioxide formed in the synthesis reaction. A low concentration of carbon dioxide in the product gas is an advantage because the removal of this material from the other products provides an additional operating expense. Thus, the principal reaction occurring with the inhibited catalysts may be represented as follows:

(1) . . . $CO + 2H_2 \rightarrow (CH_2) + H_2O$

the corresponding reaction (2), which yields carbon dioxide, is decreased.

(2) . . . $2CO + H_2 \rightarrow (CH_2) + CO_2$

As a rule, inhibited catalysts are less active than the catalysts before inhibition. As a result, conversion of synthesis gas to total hydrocarbons will be less per pass using the inhibited

catalysts, other conditions being equal. However, the percent conversion per pass of synthesis gas to hydrocarbons can be increased by raising the reactor temperature up to an appropriate operating level for the catalyst used.

Inhibition of catalysts has been successfully accomplished in both the fixed and fluid-bed type reactors. There are no fundamental differences in the results obtained by the two procedures. Addition of inhibitors can be either intermittent or continuous in order to make up for its loss from the system by reason of equilibrium considerations. However, with fixed beds there is some tendency to produce different degrees of inhibition along the bed.

Several methods of inducing initial inhibition of a fixed-bed catalyst are available. According to one, the catalyst is first activated in some way, say by reduction with hydrogen or by reaction with carbon monoxide or a mixture of hydrogen and carbon monoxide (when CO is used either by itself or in admixture with hydrogen, the process is known in the art as "forming").

After activation of the catalyst, a suitable carrier gas is passed over the catalyst at an elevated temperature sufficient to decompose the halogen compound. The carrier may be hydrogen, carbon monoxide or mixtures of the two which are known as synthesis gas. In addition, an organic halogen compound may be added in an amount which for convenience may be determine by its saturated vapor pressure.

When the inhibitor used is a gas, such as chlorine, it may be metered conveniently into a side-stream of the feed gas. The temperature of the catalyst bed during inhibition will vary depending on the halogen compound used. Temperatures of 75°-100° C. are sufficient when the halide is an easily decomposed iodine compound. Temperatures of 200°-300° C. or higher are required for the more stable bromides and chlorides. The amount of the halide used to treat the catalyst may be varied widely depending on the degree of inhibition desired. Under different conditions of treatment, the amounts could vary from 1 to 300 gm. of halogen per kilogram of catalyst.

As a specific example, iron or an iron-silica catalyst can be inhibited to obtain the benefits of this invention by treating it for 2½ hours at 400 space velocity and at 240° to 300° C. with an equimolar mixture of hydrogen and carbon monoxide feed gas. The gas should first be saturated at room temperature and 250 psig. with ethylene dichloride. This treatment increases the olefin content of the product and decreases carbon dioxide formation during synthesis.

In practice, the inhibitor may be added to the feed gas after the catalyst has been on stream and steady operation obtained. To avoid danger of complete deactivation of the catalyst, it may be desirable to start with a small amount of the inhibitor in the feed gas and gradually increase the concentration while closely following the changes in composition of the reaction products.

After a catalyst has been brought to an appropriate state of inhibition, the effects, although persisting for prolonged periods, gradually decrease. At the same time it is observed that halogen is lost from the catalyst. Hence, to maintain a constant degree of inhibition it is necessary to compensate for this loss, usually by a continuous addition of inhibitor with the feed gas. The persistence of inhibition after the removal of inhibitor from the feed stream is no doubt caused by temporary retention of halide by the catalyst.

Here's another way to introduce inhibitor to a fixed-bed catalyst: Pass a carrier gas, saturated with the inhibitor at room temperature, over a formed catalyst and at a temperature slightly above that of the carrier gas until a sufficient amount of inhibitor has been adsorbed on the catalyst. Then the catalyst with the adsorbed inhibitor is heated, generally above 200° C., to decompose the organic halogen compound.

As previously stated, the effects of inhibition disappear slowly, because of the progressive loss of halogen by the inhibited catalyst during the synthesis operation. For the most part the halogen lost appears as hydrogen halide in the liquid water product of the reactor. Thus, after the initial addition of 1 to 300 gm. of halogen per kilogram of catalyst to the catalyst, it is necessary to add inhibitor in small regulated amounts with the feed gas during operation in order that production of olefins may be kept high and CO_2 formation kept low. As a specific example, an unpromoted iron catalyst in the fluidized state required from 5 to 15 gm. of chlorine per kilogram of catalyst to effect initial inhibition of the catalyst, the chlorine being introduced as ethylene dichloride with the feed gas. Thereafter the catalyst was maintained in the inhibited state by adding ethylene dichloride to the feed gas at a rate equivalent to 0.5 gm. of chloride per kilogram of catalyst per hour (0.7 gm. of $C_2H_4Cl_2$/kg. catalyst/hr.)

It is believed that the loss of chlorine (or other halogen) from an inhibited catalyst is related to an equilibrium which exists between iron harlides and hydrone.

The curves in the chart show the effects of varying the rate of addition of inhibitor during limited periods of time. The rate of addition is plotted as the abscissa in the form of a ratio: the pressure of hydrogen chloride (calculated on the assumption that all the ethylene dichloride inhibitor added had decomposed to gaseous hydrogen chloride) divided by the pressure of HCl (calculated to be in equilibrium with $FeCl_2$ and H_2).

The expression pHCl is the partial pressure of hydrogen chloride in the wet exit gas from the reactor. It is calculated by assuming that all of the inhibitor (ethylene dichloride) added decomposed to form hydrochloric acid and that none of this was lost in the reactor. The expression $p°HCl$ is the equilibrium partial pressure of hydrogen chloride computed from the equation given above. The ratio of pHCl to $p°HCl$ then gives the theoretical excess or deficiency of the amount of inhibitor.

The data shown in the curves were obtained in an experiment with a fluidized iron catalyst prepared from magnetite. Synthesis gas ($2.2H_21CO$) was used at 60 psig., with a 1:1 ratio of recycle to fresh synthesis gas. It is to be expected that, with various modes of operation and catalyst preparation, the effects will vary somewhat in degree from the specific results shown in the graph.

The curves illustrate that the ethylene content of the C_2 fraction increases with the degree of inhibition, while the propylene content of the C_3 fraction is very high even for slightly inhibited catalysts. The methane formed decreases as inhibition increases an important effect. By increasing the amount of inhibitor, the formation of carbon dioxide can be completely suppressed but the conversion is reduced to low levels. It is probably significant that the slopes of the conversion, methane and carbon dioxide curves are very steep in the region where pHCl/$p°HCl$ is approxi-

"Soyez les Bienvenus à Montréal au Mois de Mai!"

mately 1, indicating the sharp change in the results obtained with uninhibited catalysts and with fully inhibited catalysts. Operation at ratios much greater than 1 for prolonged periods may result in an excessive chlorination of the catalyst. If so, the catalyst may be regenerated, either continuously or intermittently, by a number of methods.

A representative number of organic halogen compounds have been tested as inhibitors and found to be operative, and the invention is directed broadly to the use of any organic halogen compound that is capable of being vaporized at the reaction temperatures.

Since the experimental evidence indicates that organic inhibitors function by releasing halogens or hydrogen halides in the reactor, useful inhibition can also be obtained by treating the catalysts with the halogens themselves, i.e. chlorine, bromine and iodine; the halogne halides; or inorganic compounds capable of yielding hydrogen halides or halogens, such as carbonyl chloride.

The catalysts which are useful in this process of hydrocarbon synthesis include any of the typical iron-base catalysts which are known in the art. Iron catalysts containing promoters may be inhibited and the following promoters and supports, taken as typical of the additives which may be used with iron catalysts, have been present in significant amounts in inhibited iron-base catalysts: SiO_2, TiO_2, Cu, Al_2O_3, Cd, Ni, and K_2CO_3.

Control of the usual process variables of the hydrocarbon synthesis can be effected with the inhibited catalyst. The phenomenon of inhibition is exhibited over a wide range of these process variables.

Reaction temperature is probably the most significant process variable. The percent conversion increases with temperature for both inhibited and untreated catalysts. But the conversion per pass with an inhibited catalyst will be less for the same reaction temperature than with untreated catalyst, other conditions being equal.

There is evidence that the temperature sensitivity (i.e. change in activity with temperature) as well as the activity of the catalyst is reduced by inhibition, so that inhibition of the catalyst simplifies temperature control of the highly exothermic synthesis. Operation at temperatures of 320° to 400° C. is feasible with inhibited catalysts. In fact, the higher temperatures are not disadvantageous, since highly olefinic products are made without increase in the production of methane. With uninhibited catalysts, methane formation is pronounced at high temperatures.

Patents Issued in November

The following classified listing gives the patent number, patentee, or assignee, and a brief description of all patents of interest to the petroleum processing industries in the Official Gazette of the U.S. Patent Office for Nov. 1, 8, 15, 22, and 29, Vol. 700, Nos. 1-4.

PROCESSES

Refining

2,722,113 (Shell Development Co.) Fractionation process.

2,722,499 (Esso Research & Engineering Co.) Dewaxing process, using propane, and condensation product.

2,722,500 (Charles W. Rippie and Howard B. Bishop) Removal of acidic gases from hydrocarbon gases and liquids, using product of heating alkanolamine salt of polybasic acid.

2,722,502 (Standard Oil Co.-Ind.) Refining of hydrocarbon oils with HF and TiF.

2,722,999 (Laboratorium fur Adsorptionstechnik G. m. b. H.) Process for the separation of hydrocarbons from gaseous mixtures by adsorption.

2,723,000 (Esso Research and Engineering Co.) Method for adsorbing, desorbing, and dehydrating adsorbent in fluid adsorption system.

2,723,033-4 (Standard Oil Co.-Ohio) Liquid thermal diffusion method.

2,723,218 (Standard Oil Co.-Ind.) Refining of hydrocarbon oils with HF and TiF.

2,723,220 (Phillips Petroleum Co.) Dewaxing of lubricating oil, using urea.

2,723,221 (Phillips Petroleum Co.) Use of chelating agents to improve acid treatment of hydrocarbon streams.

2,723,222 (Phillips Petroleum Co.) Use of chelating agents to improve color and color stability of petroleum distillate.

2,723,241 (Petrolite Corporation) Process for breaking petroleum emulsions.

2,723,758 (Standard Oil Co.-Ohio) Thermal diffusion apparatus.

2,723,759 (Standard Oil Co.-Ohio) Multiple slit liquid thermal diffusion apparatus.

2,723,940 (Esso Research and Engineering Co.) Solvent extraction and recovery of solvent.

2,723,941 (Esso Research and Engineering Co.) Wax fractionation process.

2,723,942 (Esso Research and Engineering Co.) Manufacture of refined wax.

2,723,943 (Gulf Research and Development Co.) Catalytic hydrodesulfurizing of hydrocarbons.

2,723,944 (Universal Oil Products Co.) Treatment of hydrocarbon distillates with isocyanates.

2,723,945 (Standard Oil Co.-Ohio) Apparatus for conducting sweetening operations, using coalescing section.

2,723,950 (Standard Oil Co.-Ohio) Process for reduction of vapor losses in barometric condenser evacuations.

2,723,960 (Visco Products Co.) Desalting compositions for breaking emulsions.

2,724,001 (U. S. A.) Method for the recovery of tar acids from coal carbonization products by extraction in the presence of an alkali soluble hydrosulfite.

2,724,618 (Phillips Petroleum Co.) Pebble gas lift.

2,724,641 (Stanolind Oil and Gas Co.) Method for recovering elemental sulfur from gases by oxidation of H_2S.

2,724,681 (Pure Oil Co.) Production of naphthas passing the distillation-corrosion test by blending oxidatively sweetened straight run with sweet naphtha.

2,724,682 (Phillips Petroleum Co.) Sulfur dioxide extraction process for oils.

2,724,684 (Esso Research and Engineering Co.) Catalytically sweetening heating oils, using Co molybdate on alumina.

2,724,685 (The Texas Co.) Dethiolizing hydrocarbons with NaOH in glycol ether containing some polyalkene polyamine.

2,724,731 (Phillips Petroleum Co.) Solvent extraction process, rising crystallizable solvent.

Conversions

2,722,475 (Socony Mobil Oil Co.) Apparatus for the relief of expansion in systems utilizing compact masses of granular solids.

2,722,476 (Esso Research & Engineering Co.) Vacuum-type transfer line reactor.

2,722,501 (Universal Oil Products Co.) Hydrocarbon conversion process and apparatus.

2,722,503 (Esso Research & Engineering Co.) Conversion of high-sulfur oil over silica-magnesia catalyst.

2,723,180 (Socony Mobil Oil Co.) Feeding granular particles into a gas lift.

2,723,223 (Esso Research and Engineering Co.) Cracking of reduced crude with catalyst and inert particles.

2,723,224 (Socony Mobil Oil Co.) Method and apparatus for conducting moving contact material hydrocarbon conversion processes.

2,723,225 (Socony Mobil Oil Co.) Shale retorting method and apparatus.

2,723,226 (Lesher and Associates, Inc.) Low temperature carbonization process.

2,723,298 (Sun Oil Co.) Alkylation process for the preparation of alkylcyclohexanes and decalins.

2,723,300 (Esso Research and Engineering Co.) Quenching method for short-time, high-temperature gas-phase reactions.

2,723,946 (Universal Oil Products Co.) Hydrocarbon conversion process with platinum catalyst.

2,723,947 (Houdry Process Corp.) Reforming and isomerization with noble metal catalyst.

2,723,948 (Esso Research and Engineering Co.) Catalytic cracking heat exchange process.

2,723,949 (Universal Oil Products Co.) Method and apparatus for converting a hydrocarbon oil stream in the presence of a relatively thin moving particle bed.

2,723,951 (United Engineers & Constructors Inc.) Process and apparatus for the removal of finely divided solid carbonaceous particles from fluidized carbonizers.

2,724,617 (Union Oil Co. of Calif.) Start-up method and apparatus for granular solids conveyances.

2,724,619 (Union Oil Co. of Calif.) Conveyance of granular solids.

2,724,683 (Socony Mobil Oil Company) Method of improving thermal balance in hydrodesulfurization and reforming.

2,724,686 (Esso Research and Engineering Co.) Stripper for fluidized contact solids.

PRODUCTS

Chemicals

2,722,473 (California Research Corp.) Production of polysulfides by heating sulfate with sulfide.

2,722,498 (Esso Research and Engineering Co.) Process for separating organic material from inorganic material.

2,722,506 (California Research Corp.) Separation of cumene or cymene from their respective hydroperoxide by distillation.

2,722,521 (Universal Oil Products Co.) Resins and production thereof.

2,722,537 (Monsanto Chemical Co.) Production of chloranil by reacting cyclohexane with HCl and oxygen.

2,722,541 (Sun Oil Co.) Preparation of sulfonating agent.

2,722,546 (California Research Corp.) Oxidation process in presence of water soluble sulfate.

2,722,547 (California Research Corp.) Oxidation of organic compounds.

2,722,548 (California Research Corp.) Oxidation of xylenes.

2,722,549 (California Research Corp.) Oxidation process.

2,722,553 (Chemical Construction Corp.) Partial oxidation of hydrocarbons.

2,722,554 (Socony Mobil Oil Co.) Preparation of high molecular weight wax thiols.

2,722,560 (Standard Oil Co.-Ind.) Isodurene production.

2,723,240 (Esso Research and Engineering Co.) Alkyl aryl sulfonate detergent solutions.

2,723,255 (Du Pont Co.) Ester derivatives of chlorosulfonated hydrocarbon polymers.

2,723,257 (Du Pont Co.) Vulcanized chlorosulfonated polymers.

2,723,259 (Sun Oil Co.) Vinyl naphthenate polymer.

2,723,261 (California Research Corp.) High-melting polymers of para-terbutylstyrene.

2,723,287 (General Aniline & Film Corp.) Addition of 1,1 ether-esters to olefins.

2,723,289 (Sun Oil Co.) Treatment of naphthenic acids.

2,723,294 (California Research Corp.) Preparation of polymerization products from propene and pentene oxides.

2,723,299 (Mitsui Kagaku Kogyo Kabushiki Kaisha) Preparation of styrene and benzene

ALUMINUM GRATING WALKWAY & HANDRAILING

A typical installation frequently used in the petroleum industry.

See us also for:

- Pressure Vessels
- Storage & Processing Tanks
- Heat Exchangers
- Towers
- Gratings

Our pressure vessels and tanks are designed and built to comply with the requirements of the ASME code and we are authorized to apply the appropriate symbols.

WASHINGTON ALUMINUM CO., Inc.

BALTIMORE 29, MD. ● ARBUTUS 2700

NEW YORK: Murray Hill 7-0926
BOSTON: Liberty 2-7917
CLEVELAND: Yellowstone 2-6107
HOUSTON: Blackstone 6388
MOBILE: Hemlock 2-4466
NEW ORLEANS: Raymond 9744
SAN FRANCISCO: Yukon 6-2803
SEATTLE: Main 8930

ERNST STAINLESS STEEL GAGE

SHIPMENTS FROM STOCK

FIG. 8SS

Send for Catalog

Phone Livingston 6-1400

ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, N. J.

A NEW, EASY WAY TO ORDER REPRINTS

You can now use the Reader's Service Card in this issue of PETROLEUM PROCESSING to order reprints. Here's how:

- Check the list of reprints on pg. 128.
- Circle the proper "R" numbers on the Reader's Service Card (Area "C").
- Fill in your name and address —and send the card to us.

We'll bill you with the reprints

Patents

from acetylene and vinylacetylene.
2,723,983 (Union Carbide and Carbon Corp.) Disproportionation of hydrocarbon alkoxysilanes.
2,723,988 (Sinclair Refining Co.) Purification of crude foots oil oxidates.
2,723,989 (Monsanto Chemical Co.) Dicyclopentenyl thionocarbamates.
2,723,990 (Allied Chemical & Dye Corp.) Process for sulfonating detergent alkylates.
2,723,994 (Shell Development Co.) Oxidation of xylene and toluic acid mixtures to phthalic acids.
2,723,997 (Imperial Chemical Industries, Ltd.) Separation of catalysts from liquid products in carbonylation of olefinic compounds.
2,723,998 (Imperial Chemical Industries, Ltd.) Production of organic oxygen-containing compounds according to Oxo synthesis.
2,724,007 (Esso Research and Engineering Co.) Para xylene separation process.
2,724,643 (Shell Development Co.) Halohydrocarbyl substituted aromatic acids and derivatives thereof.
2,724,672 (M. W. Kellogg Co.) Method of applying thermoplastic fluoropolymers to solid surfaces.
2,724,708 (Polymer Corp. Ltd.) Ferrous and amine addition to butadiene and acrylonitrile polymerization.
2,724,728 (Sun Oil Co.) Preparation of ethers from alkyl fluoride-BF_3 in presence of silica-alumina catalyst.
2,724,729 (Hercules Powder Co.) Production of alcohols using hydrocarbon and hydroperoxide and alkali metal oxide.

Catalysts

2,722,504 (Union Oil Co. of Calif.) Silicone coated catalyst and use thereof.
2,723,243 (Universal Oil Products Co.) Manufacture of silica-metal oxide spheroids.
2,724,190 (Socony Mobil Oil Co., Inc.) Apparatus for continuously drying granular solids.
2,724,701 (W. R. Grace & Co.) Preparation of silicic acid sols.
2,724,703 (Sun Oil Company) Regeneration of platinum-containing catalyst with nitrosyl chloride.

Fuels

2,722,099 (Esso Research & Engineering Co.) Method of preventing ice formation at —50°C. and filter plugging in jet engine fuel systems by addition of tetraethylene glycol.
2,722,107 (Arthur D. Little, Inc.) Delivery tube for liquefied gases.
2,722,477 (Ethyl Corp.) Stabilized fuel antiknock (2-aminodiphenyl amine and ketone).
2,722,838 (Du Pont Co.) Device for determining the composition of sodium-lead alloy.
2,723,227 (Du Pont Co.) Process for controlling the properties of lead particles in the distillation of tetraethyl lead.
2,723,906-7 (Esso Research and Engineering Co.) Hydrocarbon fuel oil stabilized with lecithin and amine resin.
2,723,913 (Ethyl Corp.) Continuous process for the manufacture of lead-sodium alloys.

Lubricants

2,722,515 (Shell Development Co.) Metal working lubricating compositions, containing asphalt, lithopone, etc.
2,722,516 (Robert L. Merker) Grease compositions containing an antirust.
2,722,517 (Esso Research & Engineering Co.) Lubricating oil modifiers (PCl_3 products).
2,722,518 (Shell Development Co.) Synthetic lubricants (aliphatic ester of phosphorous acid).
2,723,234-6 (Lubrizol Corp.) Lubricants containing alkaline earth metal complex.
2,723,237 (The Texas Co.) Phosphoric acid esters of diethylene glycol ethers and lubricants containing the same.
2,723,286 (Esso Research & Engineering Co.) Reduction of acidity in synthetic ester lubes with ethylene carbonate.
2,723,957 (Esso Research & Engineering Co.) Synthetic lubricating oil grease containing paraffinic resins.
2,724,698 (Esso Research & Engineering Co.) Lubricating oil anti-foaming agent (amino silane).
2,724,718 (Shell Development Co.) Preparation of phosphorus-containing organic compounds.
2,724,719 (Ethyl Corp.) Process for the production of thiono phosphates.
2,724,725 (Lubrizol Corp.) Preparation of phos-

"Soyez les Bienvenus à Montréal au Mois de Mai!"

phinothioic halides from phosphinodithioic acids and hydrogen halides.
2,724,726 (Lubrizol Corp.) Preparation of phosphinic chlorides by chlorination of phosphinothioic acids with elemental chlorine.

Specialties

Re 24,094 (Frederic D. Barton) Stop-leak preparation incorporating ginger root.
2,723,233 (Esso Research & Engineering Co.) Method and composition for inhibiting corrosion by CO_2 or H_2S, using amine, etc.
2,723,910 (Phillips Petroleum Company) Plant defoliants (organic sulfides).
2,724,654 (Esso Research and Engineering Co.) Rust preventive compositions containing propane precipitated resin and mono-oleate.
2,724,697 (Sun Oil Co.) Preparation of emulsifiers for producing soluble oil (mahogany sulfonates).

Miscellaneous

2,724,271 (Sun Oil Co.) Thermal flowmeter.
2,724,717 (Esso Research and Engineering Co.) Recovery of organic oxygenated compounds from hydrocarbon oils.

EQUIPMENT

Pumps & Compressors

2,722,370 (Peter and Paul Owsen) Pressure control head for pumps.
2,722,371 (Edwards High Vacuum Ltd.) Vacuum pumping apparatus.
2,722,891 (McGraw Electric Co.) Electromagnetic pump.
2,723,622 (Norman C. Storey) Reversible pump.
2,724,340 (British Internal Combustion Engine Research Assn.) Rotary pump.
2,725,012 (McGraw Electric Co.) Motor-pump unit.

Valves & Fittings

2,722,232 (Hoffman Specialty Mfg. Corp.) Check valve.
2,722,234 (Automatic Temperature Control Co.) Poppet valves.
2,722,235 (Ira R. Havens) Mixing valve.
2,722,236 (Chong-Hung Zee) Mixing valve.
2,722,238 (Bernard D. Stuvel) Internal pipe locating fitting.
2,722,398 (General Control Co.) Fluid control valve.
2,722,437 (Titeflex, Inc.) Flexible hose fitting.
2,722,438 (Lock Joint Pipe Co.) Flexible packing for pipe in socket joint.
2,723,108 (Diamond Alkali Co.) Valve.
2,723,136 (Deublin Co.) Rotating union.
2,723,512 (Dewrance and Co.) Machines for repairing the valve seat faces of parallel slide valve.
2,724,409 (Minneapolis-Honeywell Regulator Co.) Thermostatic valve.
2,725,211 (Grinell Corp.) Diaphragm valve.
2,725,221 (Siemens Schuckertwerke) Steam conversion valve.

Processing, general

2,722,474 (Metallgesellschaft AG) Apparatus for continuous extraction of solid substances in basket conveyor extractors.
2,722,475 (Socony Mobil Oil Co.) Apparatus for relief of expansion in systems utilizing compact masses of granular solids.
2,722,476 (Esso Research & Engineering Co.) Vacuum type transfer line reactor.
2,722,501 (Universal Oil Products Co.) Hydrocarbon conversion process and apparatus.
2,722,505 (Seymour Faulkner) Method and apparatus for decolorizing oils.
2,722,507 (Celanese Corp. of America) Steam still.
2,723,109 (Stone & Webster Engineering Corp.) Vapor-to-liquid heat exchanger.
2,723,224 (Socony Mobil Oil Co.) Apparatus for conducting moving contact material hydrocarbon conversion processes.
2,723,225 (Socony Mobil Oil Co.) Shale retorting method and apparatus.
2,723,650 (Babcock & Wilcox Co.) Vapor generator.
2,723,651 (Foster Wheeler Corp.) Fluid heaters.
2,723,750 (American Cyanamid Corp.) Hydrocyclone.
2,723,758 (Standard Oil Co.—Ohio) Thermal diffusion apparatus.
2,723,759 (Standard Oil Co.—Ohio) Multiple slide liquid thermal diffusion apparatus.
2,723,945 (Standard Oil Co.—Ohio) Apparatus for conducting sweetening operations.
2,723,949 (Universal Oil Products Co.) Apparatus for converting a hydrocarbon oil stream

CLASSIFIED

UNDISPLAYED RATE

$1.50 a line. Minimum 3 lines. Box numbers count one additional line.
POSITION WANTED. Undisplayed rate is one half of above payable in advance.
DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads.

DISPLAYED RATE

The advertising rate is $13.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
All Employment Advertising is subject to Agency Commission.
ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

Send NEW ADVERTISEMENTS to Classified Advertising Division
PETROLEUM PROCESSING, *330 W. 42nd St., N. Y. 36, N. Y.*
February issue closes January 9th

DESIGNERS
DRAFTSMEN
SENIORS

PROCESS PIPING
PRESSURE VESSELS

Devenco offers design and consulting services to top American industry and stimulating, diversified assignments to creative men. Devenco, Inc. has for over a decade represented stability, security and top salaries in its field.

Rates Commensurate with Ability, Permanent Positions

Long Range Industrial & Chemical Plant Program

Convenient Interviews Will Be Arranged Locally

Send your resumé now to:
Mr. Donald Pisciotta

DEVENCO INCORPORATED
117 Liberty St., New York

DESIGN ENGINEERS
Permanent Opportunities With
McKEE
IN OUR REFINERY, METALS OR INDUSTRIAL DIVISIONS AT OUR CLEVELAND, OHIO OFFICES

McKee with more than 50 years of successful operation, doing business all over the world; is one of the largest, oldest and best known engineering and contracting firms in the business. The McKee organization continues to grow and expand, thereby offers many present and future opportunities for qualified and experienced engineers and designers in the following fields:

Piping
Structural Steel
Concrete
Process Heaters
Equipment Specs.
Also
Electrical Drafts.
Layout Engineers
Process Engineers

Applicants should have at least five years of experience.
Here is a rare opportunity for you to utilize your engineering abilities and talents.
McKee offers top compensation commensurate with experience and ability. No age limitations.
Transportation & Moving Allowances
PLEASE SEND RESUME TO:
Edward A. Kolner
ARTHUR G. McKEE & CO.
2300 Chester Ave.
Cleveland 1, Ohio

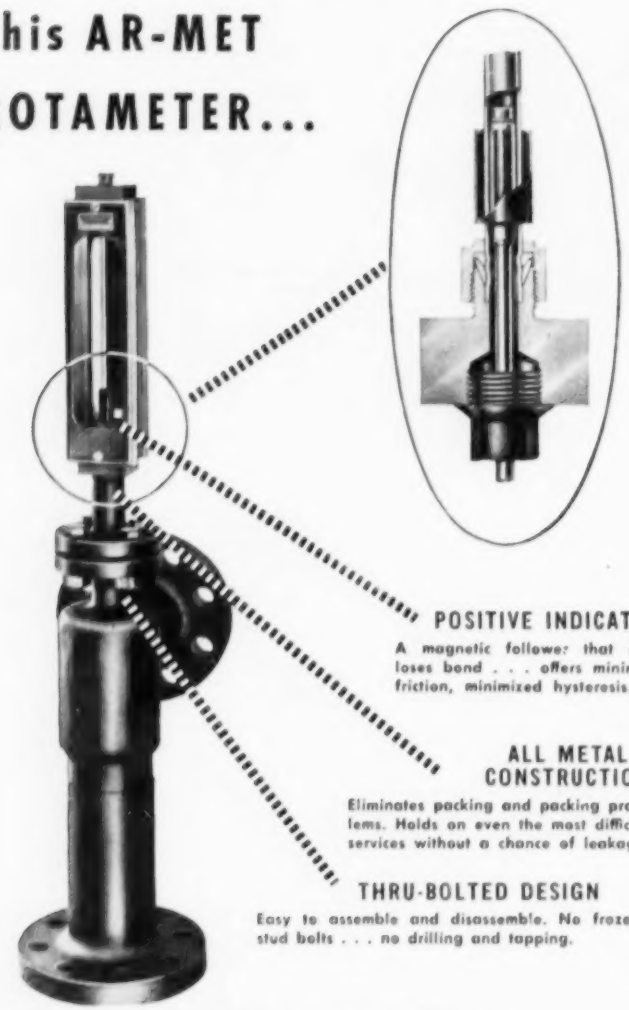
EMPLOYMENT PROBLEM?
When you are in need of specialized men for specialized jobs, contact them through an employment ad in this publication.

STEEL PIPE & TUBING
• CHROME MOLY • CARBON MOLY
• MONEL • CARBON STEEL • STAINLESS
Widest Range of Sizes & Specs in the U.S.
WRITE FOR STOCK LIST
Send us your Surplus Lists
MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

KEEP "classified" in MIND WHEN LOOKING FOR:
• Employment
• Personnel
• Equipment
• Business Opportunities
For information on rates write:
PETROLEUM PROCESSING
Classified Advertising Division **330 W. 42nd St.—New York 36, N. Y.**

BROOKS LEADERSHIP *achieved by design*

This AR-MET ROTAMETER...



POSITIVE INDICATION

A magnetic follower that never loses bond . . . offers minimized friction, minimized hysteresis.

ALL METAL CONSTRUCTION

Eliminates packing and packing problems. Holds on even the most difficult services without a chance of leakage.

THRU-BOLTED DESIGN

Easy to assemble and disassemble. No frozen stud bolts . . . no drilling and tapping.

TAKES PRACTICALLY ALL FLUIDS OFF THE "HARD TO HANDLE" LIST

If you're working with highly penetrable fluids . . . high temperatures, high pressures . . . Brooks Ar-Met Rotameters are made to order for you.

The Brooks Ar-Met Rotameter with Mag/Na/Vue indicating extension is shown . . . however, Ar-Met meters are also available with six other alarm and transmission extensions, both electrical and pneumatic. Write for Bulletin 130.

Ar-Met and Mag/Na/Vue are trade-names.

Ar-Met Rotameter Data Available in Bulletin 130.

a complete line... **BROOKS**™ **ROTAMETERS** *...for every service*

BROOKS ROTAMETER COMPANY

107 EIGHTH STREET • LANSDALE, PA.

in the presence of a relatively thin moving particle bed.
2,724,190 (Socony Mobil Oil Co.) Apparatus for continuously drying granular solids.
2,724,617 (Union Oil Co. of Calif.) Start-up method apparatus for granular solids conveyances.
2,724,686 (Esso Research & Engineering Co.) Stripper for fluidized contact solids.
2,724,954 (Adolph Messer, G.m.b.H.) Apparatus for operation of cold accumulators.
2,725,042 (Combustion Engineering Inc.) Fluid cooled tubular panels.
2,725,347 (Universal Oil Products Co.) Apparatus for distilling solid carbonaceous materials.
2,725,351 (Universal Oil Products Co.) Fractionation control system.

Instruments

Re 24,082 (Simmonds Development Corp. Ltd.) Capacitance type liquid quantity gage.
2,722,123 (Phillips Petroleum Co.) Fluid density and level recorder.
2,722,678 (William D. Kelly) Liquid level indicating means.
2,722,826 (Shell Development Co.) Continuous vapor pressure recorder.
2,722,835 (Esso Research & Engineering Co.) Recording tank gage with embossed face type.
2,723,342 (Edwin A. Neugass) Instrument lighting devices.
2,723,562 (Dorr-Oliver Inc.) Flow velocity indicating devices.
2,723,682 (Minneapolis-Honeywell Regulator Co.) Control apparatus.
2,724,269 (Secretary of Commerce) Sonic flow-measuring device.
2,724,270 (General Electric Co.) Flowmeter.
2,724,271 (Sun Oil Co.) Thermal flowmeter.
2,724,272 (Liquidometer Corp.) Liquid weight measuring system.
2,724,304 (Phillips Petroleum Co.) Differential refractometer.
2,724,962 (Republic Flow Meters Co.) Apparatus for measuring gas density.
2,724,969 (Bendix Aviation Corp.) Fluid flow-indicating apparatus.

Miscellaneous

2,722,450 (Esso Research and Engineering Co.) Pipe elevator.
2,722,855 (T. D. Williamson Inc.) Tapping apparatus.
2,725,078 (Walter P. Glancy) Flexible liner assembly for a fluid pressure device.

How to Obtain Patents

Readers may obtain copies of any U.S. patent from the Patent Office at 25¢ each. Order by patent number direct from The Commission of Patents, Washington 25, D.C.

And Now—THERE ARE TWO

"Clip-n-File" Data Sheets

- **Process Data Sheet** (pp. 87-88-89, this issue)
- **Engineering Data Sheet** (pp. 101-102, this issue)

Filled with timely, meaty, helpful material that you'll want to keep handy for everyday use.

Arranged for fast, easy reading, with subject guides on the outside edges for quick filing, indexing.

Designed for service—printed on sturdy stock, perforated for neat, easy removal and filing.

Want Reprints? See page 128

Conoflow Merges With Walworth

Conoflow Corp., Philadelphia manufacturer of final control elements, has been made an operating subsidiary of the Walworth Co., producer of industrial valves and fittings. The merger is expected to provide Conoflow with a broader financial base to expand research and development activities, increase inventory and acquire additional manufacturing facilities.

Walworth Co. sees the agreement as offering them further diversification into the field of automatic controls for the process industries, the power industry, and atomic energy industry.

No change in management, personnel or policies is expected for Conoflow as a result of the merger.

P-E Adds Spectroscope Line

Perkin-Elmer Corp. has acquired Warren Electronics, Inc., manufacturer of ultra violet spectroscopy equipment. Warren is best known for its Spectracord, a fully automatic, high-speed ultra violet recorder. Perkin-Elmer will use the company's products in its line of laboratory instruments.

Warren was founded in 1951 by Charles W. Warren as a development company providing electronic and instrument consulting services to the chemical industry. The firm will continue its operations at Bound Brook, N.J., for the present.

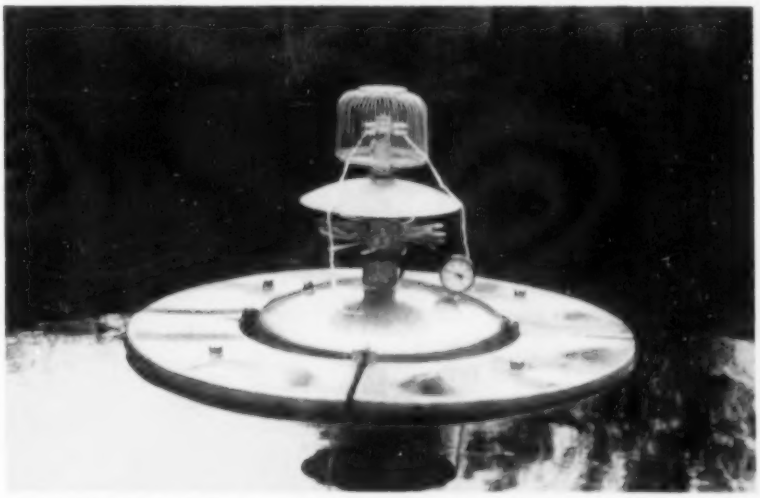
Treco Added to Vitro Group

Refinery Engineering Co. of Tulsa, engineers and constructors of petroleum refineries, natural gasoline and petrochemical plants, has been purchased by the Vitro Corp. of America.

Two affiliates of Treco, as Refinery Engineering is known, were included in the deal: Refinery Engineering Ltd., Toronto, a Canadian subsidiary, and The Refinery Engineering Co., a partnership also located in Tulsa. The price was not disclosed, but company sources have placed it between $2 and $3 million, a substantial part of it in Vitro common stock.

Vitro is a highly diversified firm, and included, before this addition, five operating divisions and two affiliated companies. Its interests are in chemical and physical research; design and engineering of processing and manufacturing facilities; development of processes, instruments, and equipment; and several other fields.

Treco is expected to round out Vitro's engineering operations by permitting actual construction within the organization.



FLOATING FIRE FIGHTER recently demonstrated in England. When the temperature in the tank rises above a set point, unit goes into action. Revolving jets spray liquids with a base of methyl bromide or chlorombromomethane over the gasoline surface. The liquids evaporate, and their heavy vapors settle and quickly smother the fire. National Fire Protection Co., Feltham, Middlesex, England, is the manufacturer.

Italy Expands Meter Production

The oil and natural gas boom in Italy has opened a larger market for Rockwell Manufacturing Co. gas meters. A Rockwell licensor in Milan recently began producing the meters in a new 100,000 sq. ft. plant, and is completing a 200,000 sq. ft. addition for the manufacture of gas hot water heaters, stoves, space heaters, and air conditioning systems.

The Italian meter plant is one-third the size of Rockwell's DuBois, Pa., plant, where production of this item in the U.S. is concentrated. Demand for natural gas in Italy, both for private and industrial consumers, is said to be just barely behind production, despite all-out efforts by the petroleum industry to find and devlop new fields.

Beckman Award to Washburn

Dr. Harold W. Washburn, vice-president and director of Consolidated Electrodynamics Corp. has been given the 1955 Beckman Award in chemical instrumentation. The $1000 award was made for Dr. Washburn's contributions to chemical analysis with the mass spectrometer.

It is known that Dr. Washburn's first mass spectrometer, developed in the 1930's, was believed doomed to failure because geophysicists lost interest in its use as an oil-prospecting tool. When World War II came Dr. Washburn turned the instrument to the development of high-octane aviation fuels and synthetic rubber. It was here that the reputation of the instrument was established. Today mass spectrometers are widely used in refineries.

The Beckman award is administered by the American Chemical Society.

"Soyez les Bienvenus á Montréal au Mois de Mai!"

Beckman Computer Output Up

The Berkeley Division plant of Beckman Instruments, Inc., will double in capacity, once the 55,000 sq. ft. addition now under construction is completed. The Richmond, Calif., plant is responding to the increasing demand for analog computers, counters, timers, and frequency measuring equipment, and to the expanded activities of the division's new systems engineering department.

The new building, which is adjacent to the existing facility, will house

the systems engineering department, increase the area used for research and development, and add to overall manufacturing capacity.

Mr. Harris

Mr. Venema

Harris, Venema in Shift at UOP

David W. Harris, president of Universal Oil Products Co. for more than 10 years, has been made chairman of the board and chief executive officer. M. O. Venema has succeeded him as president.

Mr. Harris came to Universal in 1945 from the Arkansas Natural Gas Corp. where he was also president. Before that he was president of Orange State Oil Co. and vice-president and a director of Cities Service Defense Corp.

He is a 1912 graduate of the Georgia Institute of Technology, which his father, an ex-governor of Georgia, helped found. Mr. Harris is a councilor of the American Petroleum Institute and a member of the executive committee of the Mid-Continent Oil and Gas Assn.

Mr. Venema has been with Universal for over 20 years. He is a 1932 graduate of the Armour Institute of Technology and holds an LL.B. degree from Georgetown University, which he received in 1943. He joined Universal as a junior chemical engineer and successively became a member of the company's patent department, its patent representative in Washington, manager of the patent department, vice-president and executive vice-president.

Personnel Changes

Fluor Products Corp.—George Dieter to vice-president of sales of this newly formed marketing subsidiary of the Fluor Corp.

Girdler Co.—Dr. R. M. Reed to technical advisor to the executive vice-president; C. J. Randolph to assistant chief engineer of the process section; F. A. Hilinski to assistant chief engineer of the project section. All are in the gas processes division of Girdler.

Oakite Products, Inc.—Joe D. Hudson to field manager of the petroleum service division; R. E. Tschupp to headquarters representative in New York, to assist Hudson.

Dow Chemical Co.—Wallace U. Seiler to supervisor of solvent field service.

Ethyl Corp.—William C. Ludt, from manager of the gasoline testing lab in North Kansas City, Mo., to assistant manager of the gasoline testing division with headquarters at Yonkers, N.Y.; Edward J. Otto, from deputy manager of the Kansas City lab, to manager.

Petrocarb Equipment—Russel G. Allen, executive vice-president of Godfrey L. Cabot, Inc., has replaced Dr. C. A. Stokes as director.

Blaw-Knox Co.—George E. Kopetz to vice-president in charge of production. In the chemical plants division the following became vice-president: Arne O. Olson, of engineering; Keator McCubbin, also manager of midwest headquarters in Chicago; Charles F. Hauck, of sales; and Edward S. Wright, of construction.

Pfaudler Co.—Ranlet Miner to chairman of the board; Donald A. Gaudion to executive vice-president.

Houdry Process Corp.—Dr. M. V. C. Sastri, Indian scientist, is spending three months studying fundamental catalytic research at the Linwood, Pa., laboratories. Dr. Sastri is in the U.S. for a year under an exchange agreement sponsored by the U.S. Government.

Davison Chemical Co.—W. L. Banks to sales representative in the Houston office for the petroleum catalyst department.

Hooker Electrochemical Co.—Robert E. Noble to works manager, and John B. Sutherland to sales manager. Both will be connected with the chlorine-caustic soda plant now under construction in Vancouver, B.C.

Allied Chemical & Dye Corp.—Chester M. Brown has become president of the General Chemical Division. Mark N. Biddison, the division's head since 1951, will continue with the company as an advisor and will handle special projects.

Worthington Corp.—William C. Osborne to manager of engineering, and Everett C. Schmachtenberg to assistant manager of engineering, both with the Harrison Division.

Consolidated Electrodynamics Corp.—Kenneth Hines to project chief, systems division. He has been a research physicist at Shell Oil Co.'s Houston refinery research laboratory for the past nine years and will specialize in petrochemical instrumentation for Consolidated. William M. Hawkins has become manager of the Los Angeles district sales office.

Hammond Iron Works—John C. McCauley to sales engineer, with headquarters in New York City.

Arthur G. McKee & Co.—Luther R. Hill, formerly president of Process Designs, Inc., to process coordinator of the petroleum division.

Worthington Corp.—R. K. Grobholz to manager of the power pump sales division, succeeding A. F. Welsh, who has been appointed manager of the marketing research division.

Branches, Distributors

Burgess-Manning Co. has opened a New York district sales office at 11 W. 42nd St. W. A. Carroll, Jr., is district manager, and R. T. Oliver is sales engineer.

Rockwell Manufacturing Co. of Canada Ltd. has opened a sales office at 91 Eglinton Ave., Toronto.

Conoflow Corp. has opened a new branch office at 2100 Arch St., Philadelphia. District manager is Harry J. Hartz, district sales engineer is William E. Hagan.

Expansion, Transition

Eastman Chemical Products, Inc., has moved its Dayton, Ohio, offices to 2600 Far Hills Ave.; the Houston offices are now at 704 Texas National Bank Bldg., 1300 Main St.

Fisher Governor Co. has moved into its recently completed research and engineering center at Marshalltown, Ia. About 200 of Fisher's 1250 employes are assigned to the building.

Inside story:

Valves may look alike on the surface. Their performance is another story. And the inside story of Powell Valves is that *every* Powell Valve has *Performance Verified.*

X-ray and gamma ray inspection—examining the very structure of the metal itself—are two of the many ways that Powell can make absolutely certain that Powell Valves will give *dependable* flow control.

Every part of every valve must pass rigid inspection. As a final step in manufacture, every Powell Valve is subjected to *an actual line test.* Because of Powell's pains-taking quality control, valve repair is cut to the minimum and plant shut down through valve failure is substantially reduced. Records from refineries, power and industrial plants the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our COMPLETE *quality line* which has PERFORMANCE VERIFIED.

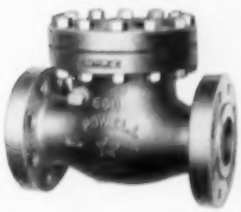
The Wm. Powell Company, Cincinnati 22, Ohio . . . 110th YEAR

PERFORMANCE PV VERIFIED

FIG. 1503—150-Pound Steel Gate Valve.

FIG. 6003—Steel Gate Valve for 600 Pounds W.S.P.

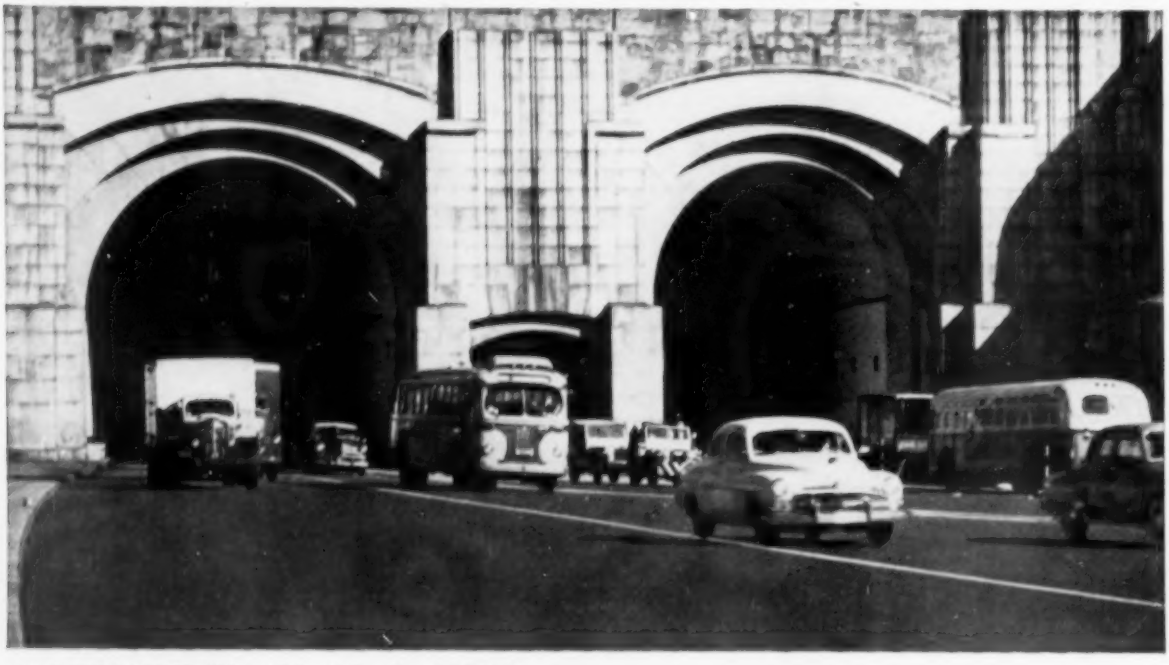
FIG. 6061—600-Pound Steel Swing Check Valve.



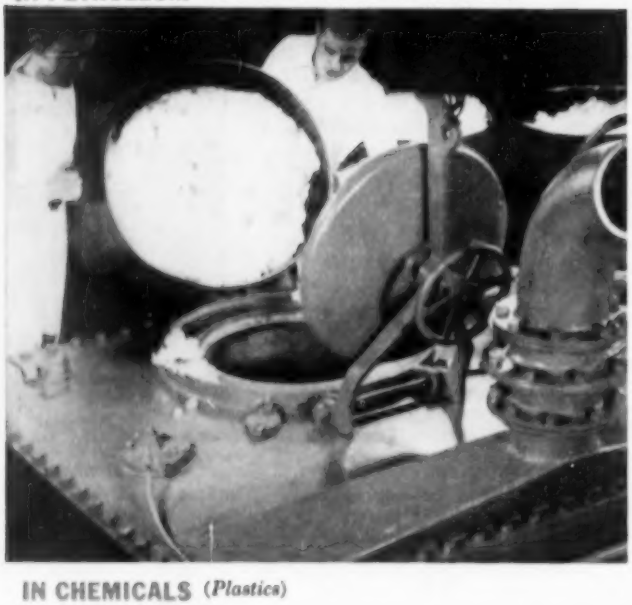
POWELL VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.

specify Enjay for fast-paced sales



IN PETROLEUM *(Motor Oil and Gasoline Additives)*



IN CHEMICALS *(Plastics)*

Rely on Enjay for top quality in your product, the kind that makes for growing demand and fast-paced selling. The Enjay Company supplies the petroleum, surface coating and chemical industries with a complete line of uniform, high quality petroleum chemicals backed by 36 years of *proved* results. You can also depend on Enjay for leadership in research and for expert technical assistance in developing new or improved products through chemistry. *Next* time, call Enjay for your chemical needs.

IN SURFACE COATINGS *(Paint, Varnish, Lacquer)*

PETROLEUM	SURFACE COATING	CHEMICAL
PARANOX	PETRONOL 91	PETRONOL 91
PARATONE	PETRONOL 95	PETRONOL 95
PARAFLOW	PETRONOL 99	PETRONOL 99
PARAPOID	JAYSOL	JAYSOL
PARADYNE	Secondary Butyl Alcohol	Iso-Octyl Alcohol
PARATAC	Secondary Butyl Acetate	Decyl Alcohol
PETROMOL	Isopropyl Acetate	Denatured Ethyl Alcohol
Methyl Ethyl Ketone	Acetone	Tridecyl Alcohol
Dewaxing Aid	Methyl Ethyl Ketone	Dicyclopentadiene
Ethyl Ether	Dicyclopentadiene	Isoprene
Isopropyl Ether	Ethyl Ether	Butadiene
Reference Fuels	Isopropyl Ether	Ethyl Ether
	Naphthenic Acids	Isopropyl Ether
RUBBER	Iso-Octyl Alcohol	Tetrapropylene
ENJAY BUTYL	Decyl Alcohol	Tripropylene
VISTANEX	Denatured Ethyl Alcohol	Aromatic Tars
		Benzene
		Acetone
		Methyl Ethyl Ketone

ENJAY

36 ***successful years of leadership in serving industry***

Enjay Company, Inc. • 15 West 51st St., New York 19, N. Y.

(To obtain more data on advertised products see page 126)

New Feature at Texas Symposium

A SERIES of short papers on instrument problems and their solutions will be a new feature of the symposium, Instrumentation for the Process Industries, to be given by Texas A. & M. College January 25 to 27. The meeting will be at the College Station campus.

Here are the instrument problems to be taken up in the 10 minutes allotted for each paper.

"Centralizing Instrument Activities," by G. J. Borque, instrument maintenance foreman of Gulf Oil Corp.'s Port Arthur, Tex., refinery.

"Analytical Instrument Maintenance," by J. R. Martin, instrument foreman at the Baytown refinery of Humble Oil & Refining Co.

"Metering of Interplant Transfer," by R. D. Hughes, engineer with Shell Chemical Corp., Houston.

"A Useful Additive Control Method," by Jack O. Gracey, instrument engineer with Carbide and Carbon Chemical Co., Texas City.

"High Frequency Methods," by Fred Jensen, head of the chemistry department of the college.

Other papers to be read during the symposium are as follows:

"This Word, Automation," by D. B. Campbell, manager, du Pont Co., Orange, Tex.

"Automation in the Industrial Process Industries," by P. S. Dickey, president, Bailey Meter Co.

"Electronic Control, Including Electrical Valve Operators," by Donald P. Eckman, associate professor of mechanical engineering, Case Institute of Technology.

"Application of Frequency Response Techniques," by J. R. Pickle, instrument engineer at the Sabine River Works of du Pont Co.

"Classification of Instrument Equipment for Hazardous Locations," by L. E. Cucklar, manager of the engineering department, Fielden Instrument Division, of Robertshaw-Fulton Controls Co.

"Practical Viewpoint of In-Line Blending," by C. L. Shultz, instrument engineer at Shell Oil Co.'s Deer Park refinery, Houston.

"Data Handling Systems in the Process Industries," by Arthur Freilich, application engineer with Minneapolis-Honeywell Regulator Co.

"Remote Tank Gaging and the New Concept in Control," by William Knesby, instrument engineer with Esso Research and Engineering Co.

In addition, there will be a panel session in which small groups will discuss one of four designated subjects.

EJC to Discuss Utilization, Engineer Growth at Meeting

Improving the utilization of engineering manpower and the "Growth Pattern of the Engineer" will be under discussion at the 1956 General Assembly of the Engineers Joint Council. The meeting will be held at the Hotel Statler, New York City, Jan. 26 and 27.

In the afternoon of the first day the Assembly will take up "Extending Engineering Manpower by Utilizing Balanced Teams of Engineers and Engineering Technicians."

Dr. Eric A. Walker, Pennsylvania State University, will open the session with a paper, "Preparation and Relative Capabilities of Engineers and Engineering Technicians."

He will be followed by Dr. L. E. Saline, of General Electric Co., who will speak on "Recruitment, Training and Placement of Technical Institute Graduates—A Centrally Controlled Program."

Dr. S. W. Herwald, Westinghouse Electric Corp., will then discuss "Planning the Ideal Engineer-Engineering Technician Team in a New Engineering Department."

Friday's discussion on the "Growth Pattern of the Engineer" will have Sidney D. Kirkpatrick, McGraw-Hill Publishing Co., as moderator, Dean Morrough P. O'Brien, University of California, will offer the views of an educator, James H. Taylor, Procter & Gamble, will speak for industry, and Robert Nelson, General Electric Co., for the employee.

Meter Assn. to Cosponsor 5th Instrument Short Course

The instrument short course given by the Los Angeles Harbor Junior College and the Southern California Meter Assn. will be held Jan. 26 and 27 for the fifth year. The course, held at the college at Wilmington, Calif., offers engineers the chance to refresh their knowledge of basic instrument principles, as well as to keep up with the new trends in instrumentation and automation.

There are three sections of the course: The usual technical papers, practical methods, and the exhibit. The sessions on practical methods are designed to train technicians in the maintenance, calibration, and application of instruments and control devices.

The exhibit is put on by instrument and control manufacturers.

Oil Man's Calendar

JANUARY

Society of Automotive Engineers, annual, Sheraton-Cadillac and Statler Hotels, Detroit, Jan. 9-13.

7th Plant Maintenance and Engineering Conference and Show, Convention Hall, Philadelphia, Jan. 23-26.

Symposium on Instrumentation for the Process Industries, Texas A. & M. College, College Station, Jan. 25-27.

5th Instrument Short Course, sponsored by the Southern California Meter Assn. and the Los Angeles Harbor Junior College, Wilmington, Calif., Jan. 26-27.

Engineers Joint Council, general assembly, Hotel Statler, New York, Jan. 26-27.

American Institute of Electrical Engineers, winter general meeting, Hotel Statler, New York, Jan. 30-Feb. 3.

FEBRUARY

American Institute of Mining and Metallurgical Engineers, annual, Hotel Statler, New York City, Feb. 19-23.

Natural Gasoline Assn. of America, Permian Basin regional meeting, Lincoln Hotel, Odessa, Texas, Feb. 25.

National Society of Professional Engineers, spring meeting, Hotel Statler, Washington, D. C., Feb. 26-29.

American Institute of Chemical Engineers, national meeting, Hotel Statler, Los Angeles, Feb. 26-29.

MARCH

Chemical Institute of Canada, 6th divisional conference, Guildwood Inn, Sarnia, Ont., Mar. 5-7.

National Assn. of Corrosion Engineers, corrosion conference, Hotel Statler, New York City, Mar. 12-16.

Western Petroleum Refiners Assn., annual, Plaza Hotel, San Antonio, Mar. 19-21.

APRIL

Corrosion Control Short Course, Central Oklahoma Section of NACE and the University of Oklahoma, at the university's Extension Study Center, Norman, Okla., Apr. 3-5.

American Society of Lubrication Engineers, annual meeting, William Penn Hotel, Pittsburgh, Apr. 4-6.

Natural Gasoline Assn. of America, annual, Texas Hotel, Ft. Worth, Apr. 11-13.

National Petroleum Assn., semi-annual, Hotel Cleveland, Cleveland, Apr. 18-20.

2nd Conference on Recording and Controlling Instruments, sponsored by the American Institute of Electrical Engineers, Bradford Hotel, Boston, Apr. 26-27.

MAY

Liquefied Petroleum Gas Assn., convention and trade show, Conrad Hilton Hotel, Chicago, May 6-9.

American Petroleum Institute, Refining Division mid-year meeting, Sheraton Mt. Royal Hotel, Montreal, May 14-17.

THE CASE OF THE RECALCITRANT TUBE

FACTS: High pressure, high temperature refinery application (hydrogenation of petroleum)
Tubing in question was stainless type 347
Tubing met original specification for job

CLUES: Tubing was in service for about 100 hours at a pressure of 10,000 psi and a temperature of 1100 F, before failure.

EXAMINATION REVEALED: Temperatures and/or pressures used in actual testing or operation exceeded the original specifications

Failure resulted from progressive wall thinning due to creep

POSSIBLE SOLUTIONS: Change operating conditions
Use a thicker wall tube. Change tube material

B&W SUGGESTION: When it comes to choosing a tube, consider *every* factor involved, including possibility of exceeding current service conditions. *And* get the benefits of Mr. Tubes' long experience with tubing for every kind of application. He knows his tubes—what they will and what they won't do. Call him in at any time. He's as close as the phone at your elbow.

TA-5044 P

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION, BEAVER FALLS, PA.

Seamless and Welded Tubular Products, Seamless Welding Fittings and Flanges—in Carbon, Alloy and Stainless Steels

Latest in Maintenance Management

Techniques of Plant Maintenance and Engineering—1955, 8½ x 11 in., 218 pages, table of contents, illustrated, hard cloth cover, $7.50, Clapp and Poliak, Inc., 341 Madison Ave., New York 17, N.Y.

THREE important advances in the field of maintenance are planning and scheduling, work measurement and standardization, and the use of punched card systems.

All say, in their own way, maintenance need not be a continual battle against emergencies. Maintenance can be planned, standardized, predicted and measured.

However, without management support and patience, the advantages of "premeditated" maintenance may never be realized.

Techniques of Plant Maintenance and Engineering—1955 brings together the papers, discussions and round table sessions held concurrently with the Sixth National Plant Maintenance and Engineering Show, Chicago, Jan. 1955 (the 1956 Maintenance show will be in Philadelphia during Jan.).

Many industries are represented in the 22 papers and 16 round table sessions, but several should be of direct interest to the refining and petrochemical reader. These include papers by W. E. Chandler of Monsanto Chemical Co. on plant buildings, F. O. Pierson[1] and E. F. Mann of Atlantic Refining Co. on work measurement and standardization, E. C. Newton of Atlantic Refining Co. and C. C. Carmine[2] of Tide Water Associated Oil Co. on planning and scheduling.

Of the round table sessions, three appear to be of special interest. The first concerned corrosion prevention and control, and was led by John McPherson of the Chemical Plants Div. of Blaw-Knox Co. The second session discussed centralization of maintenance facilities at Ethyl Corp's Baton Rouge plant,[3] and was led by M. C. Hudgins, S. A. D'Armond and B. D. Harrison.

The third session shows that although the objectives of maintenance are ageless, techniques can be adapted from other fields—specifically the use of punched card systems. As discussed by O. W. Graveley (on leave from the Electro Mettalurgical Co. to the Office of the Asst. Secy. of Defense for Properties and Installations) "if you determine maintenance cycles for all your major equipment, you'll know what jobs are coming up and you can run off the cards to determine what man-hours and materials will be required in any given period."

Thus, by the use of punched cards, maintenance management can surmount the details of manpower, work distribution, frequency of repair, backlogs, and cost.

In all, the papers, discussions and round table sessions cover many varied topics ranging from cost control, work standards, training, and scheduling to more abstract phases such as morale, working with unions, and what maintenance and management want from each other.

(1) Mr. Pierson authored an article "Standardized Maintenance Pays," PETROLEUM PROCESSING, July 1955, pp. 996-1001, discussing Atlantic's program of work measurement and job standardization.

(2) Mr. Carmine authored an article "Maintenance Dividends for You," PETROLEUM PROCESSING, Feb. 1955, pp. 192-7, discussing Tide Water Associated's use of planning and scheduling.

(3) Ethyl Corp.'s program of modernization and centralization as discussed at the Chicago Maintenance Show, was described in "How Ethyl Cut Maintenance Costs," PETROLEUM PROCESSING, April 1955, pp. 530-5.

Recent Books Briefly Noted

Compilation of Chemical Compositions and Rupture Strengths of Super-Strength Alloys, ASTM Special Technical Publication No. 170, 1955, prepared by task group of Subcommittee XII on Specifications for High-Temperature Super-Strength Alloys of ASTM Committee A-10, 9 x 12 in., 8 pp., self-cover, $0.75, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

. . . compiled for about 140 alloys with data gathered from all possible sources, and listing the probable patentee when available.

New Methods in Analytical Chemistry, by Ronald Belcher and Cecil L. Wilson, 1955, 6 x 9 in., 287 pp., index, illustrated, hard cloth cover, $5.50, Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

. . . compiles selected group of analytical methods which have been only recently discovered, or have been hidden in the vast literature of analytical chemistry.

Pocket Book of Speech Formulas, by Lester Lyle McCrery, 1955, 5½ x 8½ in., 36 pp., illustrated, paper cover, $0.60 for members of National Safety Council, $1.20 for nonmembers, National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

. . . written as a training aid for foremen and other supervisors, gives ideas to assist anyone called upon to give a safety talk—or any talk.

Sonics, Techniques for Industrial Uses of Sound and Ultrasound, by Theodor F. Hueter and Richard H. Bolt, 1955, 6½ x 9 in., 456 pp., index, hard cloth cover, 231 illus., $10.00, John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.

. . . gives unified presentation of the analysis, testing, and processing of materials and products with acoustic devices with outputs from a few cycles per second to hundreds of megacycles.

Applied Solar Energy Research, edited by E. J. Burda, 1955, 5½ x 8 in., 300 pp., table of contents, paper cover ($4.00), cloth cover ($5.00), Association for Applied Solar Energy, Suite 204, Mayer-Heard Building, Phoenix, Arizona.

. . . lists 1500 book and periodical technical and scientific references alphabetically by author, with short interpretive abstracts, for 27 countries with applied solar energy research. Also has a topical index and number system to locate material by subject.

ASTM Proceedings, 1954 edition, 6½ x 9 in., 1400 pp., author and subject indexes, hard cloth cover, illustrated, $12.00, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

. . . records technical accomplishments for ASTM during 1954, includes 37 technical papers and reports with discussions, and reports of the 68 technical committees.

A Catalogue of Devices Useful in Automatic Data Reduction, Venture R4098, Data Reduction Catalogue, WADC Technical Report 54-519, Part II, by Robert S. Hollitch and Albert K. Hawkes, Nov. 1954, 9 x 11 in., 73 pp., table of contents, paper cover, $1.50, Armour Research Foundation of Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

. . . prepared for the Air Force, catalogue summarizes characteristics of devices useful in automatic data recording and reduction systems from 41 manufacturers and 6 equipment development organizations.

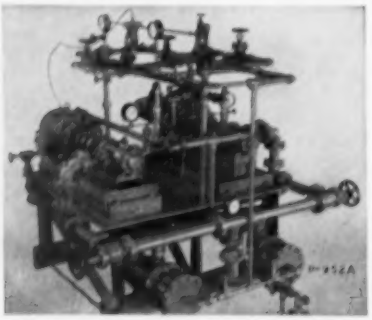
Thermodynamic Properties of Methane-Nitrogen Mixtures, Institute of Gas Technology Research Bulletin 21, by O. T. Bloomer, B. E. Eakin, R. T. Ellington and D. C. Gami, 1955, 8½ x 11 in., 53 pp., table of contents, paper cover, illustrated, $3.50, Institute of Gas Technology, 17 W. 34th St., Technology Center, Chicago 16, Ill.

. . . contains data for computing energy requirements of processes to separate nitrogen from natural gas by liquefaction and distillation, with illustrations for use of the material.

"Soyez les Bienvenus à Montréal au Mois de Mai!"

COMPLETE RANGE OF SIZES AND MODELS IN BOTH MEDIUM AND HIGH PRESSURE TYPES

MORE COMPACT THAN EVER . .



P-952-A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-852H size No. 25 unit.

NATIONAL AIROIL

FUEL OIL PUMPING AND HEATING UNITS

NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 4C—very interesting and informative.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMP and HEATING UNITS
FURNACE RELIEF DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1297 East Sedgley Avenue, Philadelphia 34, Pa.
Southwestern Division:
2512 South Boulevard, Houston 6, Texas

Information Offered in the Advertisements

ALUMINA BALLS, samples and information; Alcoa Chemicals. See adv't. p. 145.

ANALYZERS, for light hydrocarbons, booklet 82; Burrell Corp. See adv't. p. 146.

BARIUM CHEMICALS, for gasoline additives, booklet; Westvaco Mineral Products. See adv't. p. 24.

BUBBLE CAPS, catalog 22; Pressed Steel Co. See adv't. p. 136.

CATALYST, boron trifluoride, information; Baker & Adamson, Gen'l Chemical Div. See adv't. cover 3.

CATALYSTS, tableted, booklet; Harshaw Chemical Co. See adv't. p. 1.

CATALYTIC REFORMING, new process, booklet; M. W. Kellogg Co. See adv't. pp. 30-31.

COMPRESSORS, gas, 265-660 horsepower, bulletin; Cooper-Bessemer Corp. See adv't. p. 19.

EXPANSION JOINTS, bulletin 351; Zallea Brothers. See adv't. p. 25.

FLANGES, drop forged, catalog; Phoenix Mfg. Co. See adv't p. 146.

FLOW MEASUREMENT, rotameter, bulletin 130; Brooks Rotameter Co. See adv't. p. 116.

FLOW TRANSMITTER, new features, bulletin 13-11; The Foxboro Co. See adv't. pp. 22-23.

FURNACES AND HEATERS, gradiation, bulletins; Selas Corp. of America. See adv't. p. 81.

HEATING UNITS, for fuel oil, bulletin 4C; National Airoil Burner Co., Inc. See adv't. p. 124.

HOT PLATES, for laboratory use, bulletin 1001-A; Lindberg Engineering Co. See adv't. p. 142.

HYDROCARBON BLENDS, C_7 & C_8, technical paper describes research; Ethyl Corp. See adv't. pp. 4-5.

INSULATION, high temperature, glass fiber, catalog; Owens-Corning Fiberglas Corp. See adv't. p. 29.

JACKETED PUMPS, pipes, valves, bulletin J-50; Hetherington & Berner, Inc. See adv't. p. 136.

MECHANICAL SEALS, "Teflon," bulletin MS-1155; U. S. Gasket Co. See adv't. p. 150.

METAL DEACTIVATOR, to control copper compounds, data and samples; Tretolite Co. See adv't. p. 18.

MIXERS, side and top entering, eight catalogs; Mixing Equipment Co. See adv't. p. 38.

MIXERS, various types, catalog series 29; Eastern Industries, Inc. See adv't. p. 26.

MOTOR STARTERS, for hazardous locations, booklet 1062-VIII; Electric Controller & Mfg. Co. See adv't. p. 156.

PROCESS EQUIPMENT, fabrication and service, bulletins; Condenser Service & Engr. Co., Inc. See adv't. p. 138.

PROCESS EQUIPMENT, fabrication, booklet; Newport News Shipbuilding & Drydock Co. See adv't. p. 149.

STAINLESS STEEL, for valves, fittings, etc., engineering data; Cooper Alloy Corp. See adv't. p. 130.

STEAM TRAPS, catalog 953; W. H. Nicholson & Co. See adv't. p. 27.

STEAM TRAPS, impulse type, booklet; Yarnall-Waring Co. See adv't. p. 141.

STORAGE and transportation facilities, booklet; Hess Terminals Corp. See adv't. p. 154.

THERMOMETERS, dial, various ranges, bulletin 98267; Taylor Instrument Cos. See adv't. p. 36.

TUBE FITTINGS, fabricated from many materials, catalog; Crawford Fitting Co. See adv't. p. 94.

TUBE CLEANING, and expanding tools, literature; Airetool Mfg. Co. See adv't. p. 148.

TUBING, condenser, booklet; Wolverine Tube. See adv't. pp. 36A-36B.

VALVES, control, motor operated, new catalog; Annin Co. See adv't. p. 104.

VALVES, fittings and flanges, drop forged, catalog F-9; Henry Vogt Machine Co. See adv't. p. 21.

Let's face it!

HAVE YOU A DISASTER PLAN FOR YOUR PLANT?

BOMBS...OR FIRE...OR FLOOD...OR TORNADO ...you can handle them if you act now.

Let's face it... the threat of war and the atomic bomb has become a real part of our life—and will be with us for years. Fires, tornadoes and other disasters, too, can strike without warning.

Whatever the emergency is, everybody's going to want help at the same time. It may be hours before outside help reaches you. The best chance of survival for you and your workers—and the fastest way to get back into production—is to know what to do and be ready to do it. Disaster may happen TOMORROW. Take these simple precautions TODAY:

☐ **Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's integrated with community Civil Defense action.

☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

☐ **Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads and official CD films or literature that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

Act now . . . check off these four simple points . . . before it's too late.

FOR INFORMATION ON ANY PRODUCT OR SERVICE IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products, or services which interest him. This code letter appears in parantheses following the advertiser's name.

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card . . . no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

ADVERTISERS' INDEX

A

Airetool Mfg. Co. **(H-8)** 148
Air Preheater Corp. **(H-2)** 143
Aluminum Co. of Amer., Chemicals Div. **(H-4)** 145
American Cyanamid Co., Refinery Chem. Dept. **(J-8)** 157
Annin Co. **(E-6)** 104

B

Babcock & Wilcox Co. **(F-6)** 122
Baker & Adamson, Gen'l Chem. Div. **(J-9)** Cover 3
Betz, W. H. & L. D. **(B-3)** 20
Bingham Pump Co. **(G-7)** 139
Black, Sivalls & Bryson, Inc. **(H-7)** 147
Brooks Rotameter Co. **(F-3)** 116
Burrell Corp. **(H-5)** 146

C

Chicago Bridge & Iron Co. **(C-5)** 32
Condenser Service & Engr. Co. **(G-6)** 138
Cooper Alloy Corp. **(F-8)** 130
Cooper-Bessemer Corp. **(B-2)** 19
Crane Co. **(D-6)** 86
Crawford Fitting Co. **(E-1)** 94

D

Dowell, Inc. **(C-7)** 34
DuPont de Nemours & Co., Inc. **(B-4)** 20A-20B
DuPont de Nemours & Co., Inc. **(E-9)** 110

E

Eastern Industries, Inc. **(B-9)** 26
Electric Controller & Mfg. Co. **(J-7)** 156
Enjay Co. **(F-5)** 120
Ernst Water Column & Gage Co. **(F-2)** 114
Ethyl Corp. **(A-3)** 4-5
Ever-Tite Coupling Co., Inc. **(F-9)** 131

F

Foster Wheeler Corp. **(E-4)** 100
Foxboro Co. **(B-6)** 22-23

G

Gen'l American Trans Corp., Plate & Welding Div. **(A-4)** 6
Gen'l American Trans Corp., Terminals Div. **(A-5)** 8
General Refractories Co. **(C-6)** 33
Graver Tank & Mfg. Co. **(A-8)** 14

H

Harshaw Chemical Co. **(A-2)** 1
Hercules Powder Co. **(A-6)** 11
Hess Terminal Corp. **(J-5)** 154
Hetherington & Berner, Inc. **(G-5)** 136
Hudson Engineering Corp. **(A-1)** Cover 2

I

International Nickel Co. **(J-2)** 151

J

Johns-Manville Corp. **(E-7)** 107

K

Kellogg Co., M. W. **(C-4)** 30-31
Key Co. **(C-8)** 35

L

Lindberg Engineering Co. **(H-1)** 142
Lukens Steel Co. **(D-8)** 91
Lummus Co. **(A-7)** 13

M

McKee Co., Arthur G. **(G-1)** 133
Mixing Equipment Co. **(D-2)** 38

N

National Airoil Burner Co. **(F-7)** 124
National Aluminate Corp. **(A-9)** 17
Newport News Shipbuilding & Drydock Co. **(H-9)** 149
Nicholson & Co., W. H. **(C-1)** 27
Nitrogen Div., Allied Chem. & Dye Corp. **(D-5)** 84
Norton Co. **(J-6)** 155

O

Oakite Products, Inc. **(E-2)** 95
Olin Mathieson Chemical Co. **(J-4)** 153
Oronite Chemical Co. **(C-2)** 28
Owens-Corning Fiberglas Corp. **(C-3)** 29

P

Patterson Foundry & Mach. Co. **(G-2)** 134
Petro-Chem Development Co. **(D-9)** 92
Petreco **(D-7)** 90
Phoenix Mfg. Co. **(H-6)** 146
Powell Co., William **(F-4)** 119
Pressed Steel Co. **(G-4)** 136
Procon, Inc. **(E-5)** 103

R

Rhodia, Inc., Alamask Div. **(J-3)** 152
Ridge Tool Co. **(H-3)** 144
Rockwell-Nordstrom Valves **(E-8)** 108

S

Selas Corp. of America **(D-3)** 81

T

Taylor Instrument Cos. **(C-9)** 36
Tennessee Corp. **(G-8)** 140
Tretolite Co. **(B-1)** 18

U

U. S. Gasket Co. **(J-1)** 150
U. S. Steel Corp. **(G-3)** 135
Universal Oil Products Co. **(D-4)** 82-83

V

Vogt Machine Co., Henry **(B-5)** 21

W

Warren Petroleum Corp. **(E-3)** 96
Washington Aluminum Co. **(F-1)** 114
Westvaco Mineral Prods. **(B-7)** 24
Wolverine Tube, Div. Calumet & Hecla, Inc. **(D-1)** 36A-36B
Wyatt Metal & Boiler Works **(K-1)** Cover 4

Y

Yarnall-Waring Co. **(G-9)** 141

Z

Zallea Brothers **(B-8)** 25

CLASSIFIED ADVERTISING
F. J. Eberle, Ass't Mgr.

EMPLOYMENT OPPORTUNITIES 115
EQUIPMENT (Used or Surplus New) For Sale 115

This index is published as a convenience to the reader. Every care is taken to make it accurate, but PETROLEUM PROCESSING assumes no responsibility for errors or omissions.

Use these handy **Reader Service Cards** for

A—More details on What's New items

B—Information on Advertised Products

C—Special reports, articles and Data Sheets

D—New or renewal subscription orders

A Are You Up-to-Date on What's New?

. . . get the **latest** details on the **newest** in—

- Equipment and materials
- Services
- Helpful literature

Read the reviews in the **What's New** section on the following pages, pick out the items that interest you, then circle the corresponding number in Area **"A"** on the **Reader Service Card.**

B More on Advertised Products

. . . do you want to know more about products or services advertised in this issue of PETROLEUM PROCESSING, or get copies of the literature offered in the ads? Refer to the **Advertisers' Index** on the preceding page for key numbers to circle in Area **"B"** on the **Reader Service Card.**

C Special Reprints Available

. . . do you need reprints of PETROLEUM PROCESSING's special reports, articles or **Data Sheets?** If so, see the other side of this sheet for order numbers and prices, then use Area **"C"** on the **Reader Service Card** to order them. We'll bill you later.

D Are You a "Pass-on" Reader?

. . . get your own personal copy of PETROLEUM PROCESSING promptly every month at low rates. Just check your choice in Area **"D"** on the **Reader Service Card**—we'll send your bill later, after you start getting your copies.

READER SERVICE CARD

A—WHAT'S NEW ITEMS *Circle proper number*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

B—ADVERTISED PRODUCTS *See Index on facing page*

A1	B1	C1	D1	E1	F1	G1	H1	J1	K1	L1	M1	N1	O1	P1	Q1	S1	T1	U1	V1
A2	B2	C2	D2	E2	F2	G2	H2	J2	K2	L2	M2	N2	O2	P2	Q2	S2	T2	U2	V2
A3	B3	C3	D3	E3	F3	G3	H3	J3	K3	L3	M3	N3	O3	P3	Q3	S3	T3	U3	V3
A4	B4	C4	D4	E4	F4	G4	H4	J4	K4	L4	M4	N4	O4	P4	Q4	S4	T4	U4	V4
A5	B5	C5	D5	E5	F5	G5	H5	J5	K5	L5	M5	N5	O5	P5	Q5	S5	T5	U5	V5
A6	B6	C6	D6	E6	F6	G6	H6	J6	K6	L6	M6	N6	O6	P6	Q6	S6	T6	U6	V6
A7	B7	C7	D7	E7	F7	G7	H7	J7	K7	L7	M7	N7	O7	P7	Q7	S7	T7	U7	V7
A8	B8	C8	D8	E8	F8	G8	H8	J8	K8	L8	M8	N8	O8	P8	Q8	S8	T8	U8	V8
A9	B9	C9	D9	E9	F9	G9	H9	J9	K9	L9	M9	N9	O9	P9	Q9	S9	T9	U9	V9

C—REPRINTS AVAILABLE *See listing on next page*

R1	R4	R7	R10	R13	R16	R19	R22	R25	R28	R31	R34	R37	R40	R43	R46				
R2	R5	R8	R11	R14	R17	R20	R23	R26	R29	R32	R35	R38	R41	R44	R47				
R3	R6	R9	R12	R15	R18	R21	R24	R27	R30	R33	R36	R39	R42	R45	R48				

D—NEW OR RENEWAL SUBSCRIPTION

New ☐ Renewal ☐ 1 year—$2.00 ☐ 2 years—$3.00 ☐ 3 years—$4.00 ☐

Petroleum Processing

For Issue of January, 1956 (Good until April 15, 1956)

Name *(please print)* _____

Position _____

Company _____

Business Address _____

City _____ Zone _____ State _____

FIRST CLASS
PERMIT NO. 64
(Sec. 34.9 P. L. & R.)
New York, N. Y.

BUSINESS REPLY CARD
No Postage Necessary if Mailed in the United States

4c-POSTAGE WILL BE PAID BY

PETROLEUM PROCESSING
330 WEST 42nd STREET
NEW YORK 36, N. Y.

FIRST CLASS
PERMIT NO. 64
(Sec. 34.9 P. L. & R.)
New York, N. Y.

BUSINESS REPLY CARD
No Postage Necessary If Mailed in the United States

4c-POSTAGE WILL BE PAID BY

PETROLEUM PROCESSING
330 WEST 42nd STREET
NEW YORK 36, N. Y.

Use these handy **Reader Service Cards** for

A—More details on What's New items
B—Information on Advertised Products
C—Special reports, articles and Data Sheets
D—New or renewal subscription orders

PETROLEUM PROCESSING Reprints

Need more copies of the following reprints? If so, check the numbers of items wanted and circle them on Area **"C"** of the **Reader Service Card.** We'll fill your order right away, and send your bill later.

• **Vaporization Equilibrium Constant and Activity Coefficient Charts**—for conditions up to system critical point. 48 pages—$1.50: Circle **R1** on Card.

• **Refinery Instruments, What Makes Them Tick?**—covering flow, level and temperature measurement; controlers, control valves and pneumatic transmission. 40 pages—$1.00: Circle **R2** on Card.

• **Catalytic Reforming Survey**—with trends, theory and processes for catalytic reforming and aromatics recovery. 48 pages—$0.75: Circle **R3** on Card.

• **Clip·n·File Process Data Sheets**—with flow diagrams, process description, conditions and economics. 3 page fold-out sheets—$0.20 each.

PDS No. 1, **Ethylene Oxide** Circle **R4** on Card
PDS No. 2, **Butadiene·Butenes** Circle **R5** on Card
PDS No. 3, **L'Azote Ammonia** Circle **R6** on Card

• **Clip·n·File Engineering Data Sheet.** 2 pages—$0.20.

EDS No. 1, **Pressure Fundamentals** Circle **R7** on Card

Prices for quantity orders furnished on request.

READER SERVICE CARD

A—WHAT'S NEW ITEMS *Circle proper number*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

B—ADVERTISED PRODUCTS *See Index two pages back*

A1	B1	C1	D1	E1	F1	G1	H1	J1	K1	L1	M1	N1	O1	P1	Q1	S1	T1	U1	V1
A2	B2	C2	D2	E2	F2	G2	H2	J2	K2	L2	M2	N2	O2	P2	Q2	S2	T2	U2	V2
A3	B3	C3	D3	E3	F3	G3	H3	J3	K3	L3	M3	N3	O3	P3	Q3	S3	T3	U3	V3
A4	B4	C4	D4	E4	F4	G4	H4	J4	K4	L4	M4	N4	O4	P4	Q4	S4	T4	U4	V4
A5	B5	C5	D5	E5	F5	G5	H5	J5	K5	L5	M5	N5	O5	P5	Q5	S5	T5	U5	V5
A6	B6	C6	D6	E6	F6	G6	H6	J6	K6	L6	M6	N6	O6	P6	Q6	S6	T6	U6	V6
A7	B7	C7	D7	E7	F7	G7	H7	J7	K7	L7	M7	N7	O7	P7	Q7	S7	T7	U7	V7
A8	B8	C8	D8	E8	F8	G8	H8	J8	K8	L8	M8	N8	O8	P8	Q8	S8	T8	U8	V8
A9	B9	C9	D9	E9	F9	G9	H9	J9	K9	L9	M9	N9	O9	P9	Q9	S9	T9	U9	V9

C—REPRINTS AVAILABLE *See listing at left*

R1	R4	R7	R10	R13	R16	R19	R22	R25	R28	R31	R34	R37	R40	R43	R46
R2	R5	R8	R11	R14	R17	R20	R23	R26	R29	R32	R35	R38	R41	R44	R47
R3	R6	R9	R12	R15	R18	R21	R24	R27	R30	R33	R36	R39	R42	R45	R48

D—NEW OR RENEWAL SUBSCRIPTION

New ☐ Renewal ☐ 1 year—$2.00 ☐ 2 years—$3.00 ☐ 3 years—$4.00 ☐

Petroleum Processing

For Issue of January, 1956 (Good until April 15, 1956)

Name *(please print)* _____

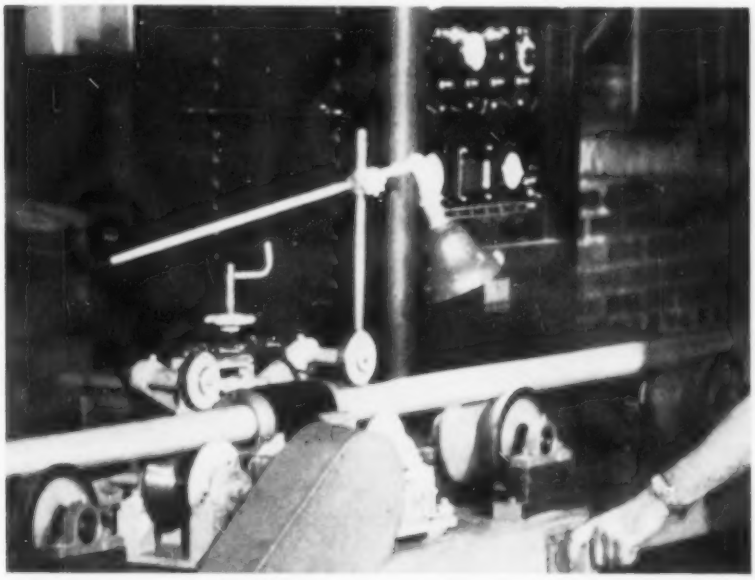
Position _____

Company _____

Business Address _____

City _____ Zone ____ State ____

WHAT'S NEW . . .



Magnetic Analyzer

Detects Tiny Flaws in Tubing

By using the exactness of magnetic permeability, a non-destructive test unit will pick out any variation in the chemistry, wall thickness, or outside or inside diameter of stainless steel tubing. Accuracy of up to 3% variation is detectable.

After many months of trial on a pilot run basis, Carpenter Steel Co.'s Alloy Tube Division plant in Union, N. J. has added this new test unit to its production facilities. All material is being handled at production speeds of 250 ft/min. at present.

Tubing is inspected on the inside as well as the outside diameter surfaces and around the entire periphery. Wall thicknesses up to 0.070 in. are accurately gauged during inspection. If tubing of the wrong thickness or incorrect diameters is mixed with a standard batch, the test unit will signal the operator the instant it runs through the magnetic coil.

Present equipment will inspect tubing with outside diameters ranging from ¼ to 3¼ in. It is hoped that eventually all sizes of tubing and pipe can be accommodated in this non-destructive test unit. This quality control measure reveals many flaws which are extremely difficult to detect by other methods including: inside carburization, "weepers", nicks, dents, finish variations, weld permeability, split grooves, and holes.

Audio-visual signals warn the operator the instant a defect passes, and test results are always visible on the unit's oscilloscope. Sensitivity control makes it possible to indicate defects of a pre-determined magnitude. The unit is manufactured by **Magnetic Analysis Corp.,** Long Island, N. Y.

Circle No. **17** *on Reply Card*

For More Information

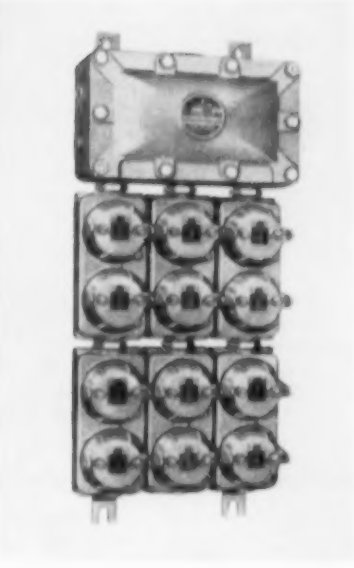
Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage is required.

Catalyst for Cracking

. . . **resists metallic poisoning,** and can be tailored to refiners' specification.

This new series of high alumina content is available as closely sized microspheres for fluid cracking, or high hardness pellets for all types of moving bed processes. The results of pilot and full-scale tests indicate high gasoline yields with low coke production. **The Filtrol Corp.,** 3250 E. Washington Blvd., Los Angeles 23, Calif.

Circle No. **18** *on Reply Card*



Safe Condulet Assembly

. . . **for load centers or panelboards** is explosion-proof and dust-tight.

All terminal blocks are located in the upper housing, and circuit breakers with external handles are grouped underneath. Connections between the two sections are factory wired, with seals between all housings. "Type EWP" panelboards can be furnished inverted with branch connections at the bottom.

Designed for wiring systems up to 120 volts, the circuit breakers have handles which can be padlocked in either the "on" or "off" position. The thermal-magnetic breakers are trip-free from these handles, and cannot be held closed under overload or short circuit conditions. The terminal blocks come in two sizes: a larger one handles up to 24 single-pole circuit breakers, the smaller up to 12 single-pole breakers. **Crouse-Hinds Co.,** Wolf & Seventh North Sts., Syracuse 1, N. Y.

Circle No. **19** *on Reply Card*

COOPER ALLOY

CORPORATION BRIEFS

• Edited by GEORGE BLACK

ENGINEERING DATA BOOK

Another section of the new Cooper Alloy catalog being readied by the Valve and Fitting Division is now available. Referred to as "Stainless Steel Engineering Data," this 16 page manual includes a variety of tables and charts of reference value for those who work with stainless steel valves, fittings, pipe, tubing or castings. Your copy is waiting.

ADVANCED KNOW-HOW #1

The full story behind the Shellcast® stainless steel jet engine support rings being turned out by the Foundry Products Division of Cooper Alloy is told in Advanced Know-How Report #1. The problem, the specifications and the solution are covered in detail with text and photos. Write for your copy.

PUMPING ETCH ROOM SOLUTIONS

Transferring acids and salt solutions used in the Etch Room of Litho Chemical & Supply Co. caused repeated pump failure and constant shaft seal maintenance. Five years ago a Vanton plastic pump (no stuffing box, no shaft seals) was put into daily service. Customer reports "no maintenance except lubrication." Full story appeared in Chemical Processing (July). Reprint available on request.

QUIKUPL DATA POPULAR

Since the publication of the May issue of Newscast which featured this patented fitting, the requests for additional data have been pouring in. In case you missed the issue, may we remind you that copies are still available. Full engineering data, case histories and photographs are included, making it possible for you to see for yourself just how this unique stainless steel fitting can cut your installation and operating costs.

COOPER ALLOY
CORPORATION • HILLSIDE, N.J.

New Microwave Device

Sends Maps and Photos by Radio

Long distance transmission of maps, photographs, and other graphic material over the same radio circuits that normally carry voice messages can now be accomplished with a new development in microwave technology.

Using the facilities of Texas Illinois Natural Gas Pipeline Co., which operates a private 12-channel microwave system, facsimile engineers demonstrated how to send maps and photographs from Chicago to Houston in a special test run.

Copy to be transmitted is wrapped around a rotating drum and scanned by an optical system. Light reflected from the scanned copy varies with the density of the marking. Through a phototube these variations are converted into varying voltages. White portions of the copy give maximum output and black minimum output.

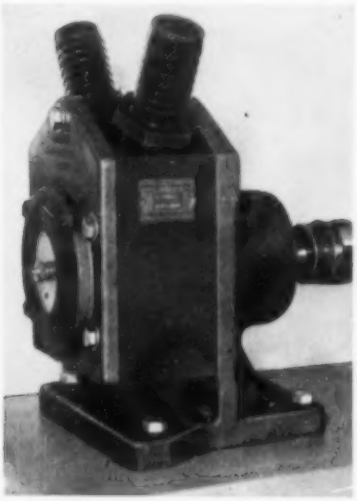
The output of the facsimile transmitter is converted into an audio frequency tone, in which white is set at zero level with black falling to about —30 db. When the AM audio tone is received it is demodulated to varying voltages, which are converted back to varying light intensities. The graphic reproduction is made on photographic paper or electrolytically etched on facsimile paper.

Using facsimile equipment, copy rolled off the recorders at the rate of 1-in./min. with a 9 inch maximum line. At this rate a 9 x 12 inch map can be sent thousands of miles and received at a distant point in 12 minutes.

Some uses suggested by the test include: transmission of photos of field equipment failures, verification of signatures and documents, central examination of engine performance charts, and aerial photos. Some distortion should be expected in present transmission equipment, such as dimensional changes of photographic film or facsimile paper when it is dried. For this reason it would not be possible to integrate transmitted charts for billing purposes.

One limitation of present facsimile equipment, which may be overcome by a new flat scanner, is the small 9 x 12 copy size of the rotating drum type. At present it is necessary to cut large documents (maps and logs) into smaller segments for transmission. The manufacturer of the facsimile equipment used is Acme Telectronic Division of NEA Service Inc. The 12-channel microwave system was produced by **Motorola Communications & Electronics, Inc.**, 4501 W. Augusta Blvd., Chicago 51, Ill.

Circle No. **20** *on Reply Card*



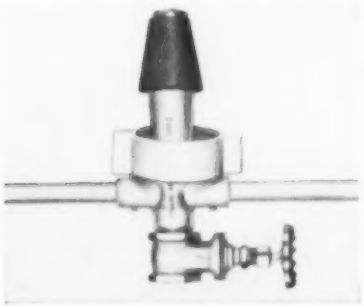
Plastic Pump

. . . **eliminates conventional stuffing box and mechanical seal,** with the liquid never touching metal.

Although the pump rotor, shaft, and bearing assemblies are of stainless steel, the pump housing and "Flex-i-liner" are made of plastic that allows handling corrosive chemicals, abrasive slurries, or special fluids. The cantilever mounting of the pump head permits quick replacement of the liner, without removing the motor connections or pipelines.

This series of pumps is available in 10-, 15-, and 20-gpm sizes. Discharge pressure ratings are from 0 to 50 psi. **Vanton Pump & Equipment Corp.,** 201 Sweetland Ave., Hillside, N. J.

Circle No. **21** *on Reply Card*

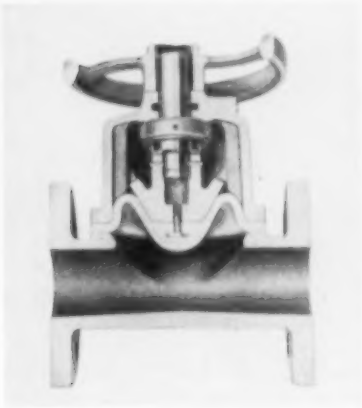


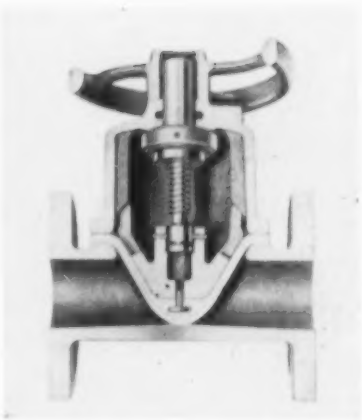
Leak Stopper

. . . **for tank car unloading prevents loss** through outlets.

Designed to plug a leak in any standard unloading nozzle, this device fulfills two requirements. First, if the tank car valve is leaking when the cap is removed the neoprene stopper will plug the outlet immediately. Secondly, after the attached collar is threaded onto the outlet, the flow can be controlled by the valve which is a part of the device. Made of non-sparking aluminum, the stopper weighs nine lb. without its standard 2-in. valve. **Arbit Trading Co.,** 30 Church St., New York 7, N. Y.

Circle No. **22** *on Reply Card*





Diaphragm Valve

. . . **allows straight-through flow** for viscous materials or slurries.

This weir type diaphragm valve will close firmly even when handling gritty or fibrous materials. The separation of the replaceable diaphragm from the bonnet means simple maintenance; there is no packing gland or disc holder with a metal-to-metal seat. If it is necessary to rod or brush out the line, removing the valve bonnet is not required; the diaphragm may be withdrawn completely from the pipe I.D. **Grinnell Co., Inc.,** Saunders Valve Dept., 260 West Exchange St., Providence 1, R. I.

Circle No. **23** *on Reply Card*

EVER-TITE
Standard Adapter
and Coupler

Your best buy is

EVER-TITE
-the best quality
QUICK COUPLINGS

EVER-TITE
Adapter and
Coupler

EVER-TITE
Shank Hose
Coupling

You save *time* and *money* when you use Ever-Tite Couplings because they speed-up deliveries, prevent leakage, and save wear on equipment.

Tightness is predetermined in manufacture by positive gasket compression. There are no sliding rings—no springs, ball bearings, snaps or lugs to fit. You just slip the coupler over the adapter, and close the handles.

If you want to get the *most* in coupling value get *Ever-Tite.* The Ever-Tite Trademark is a hallmark of dependability in fittings for the petroleum industry—proved by 18 years of pre-eminence. Ask your distributor now.

EVER-TITE COUPLING CO. INC.
254 West 54th Street
New York 19, N. Y.

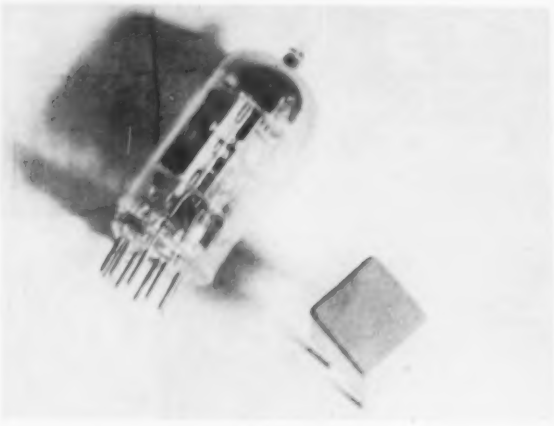
Dust Plug

Dust Cap

EVER-TITE Dust Protectors

Every EVER-TITE saves time and money

(To obtain more data on advertised products see page 126)



Tiny Magnetic Amplifier

Replaces Vacuum Tube

A small magnetic amplifier, measuring ¾" on all sides, forms the basis for two new instruments that count and measure thousands of times a second.

The plastic cube (pictured above, left) contains a miniature wire-wound magnetic amplifier which performs most of the functions of a vacuum tube. These devices, trade-named "Ferristors," are immune to shock, vibration, and moisture—and produce little or no heat. Whereas a vacuum tube is expected to last about 500 hours, this new magnetic amplifier is claimed to give trouble-free service for at least five years.

This ruggedness and long life have been used in two new "magnetic" instruments. A counter-controller (pictured above, right) is capable of 10,000 counts per second with complete accuracy. Requiring only two vacuum tubes and the new "Ferristors"—instead of the 54 vacuum tubes in a comparable electronic model—the magnetic counter produces output signals at each of two presettable count totals. Input count impulses may be obtained from photocells, magnetic pickups, or electrical contacts. Output signals rated at 5-amps will operate solenoids, power relays or other control devices.

Another instrument using the Ferristors is the "Berkeley EPUT" meter which measures events occurring during precise 0.1, 1 or 10-second intervals. Results are displayed in direct-reading digital form. It can measure temperature, flow, velocity, viscosity, frequency, rpm, or count objects at rates to 40,000 counts per second. The meter operates from photocell, magnetic pickup or any suitable transducer. Applications include process control systems, data reduction systems or measurement of any optical, electrical, mechanical or physical events occurring during a precise time interval. Berkeley Division, **Beckman Instruments, Inc.,** 2200 Wright Ave., Richmond 3, Calif.

Circle No. **24** *on Reply Card*

Steam Cleaning Gun

. . . **protects the operator** by using the cleaning solution to reduce the external temperature of the gun.

Essentially a tube within a tube, the "Hurriclean Gun" has steam passing within the inner tube and cleaning solution through the exterior tube. The steam loses little of its heat while the solution cools the barrel for safe operation as it passes through the gun, drawn by the partial vacuum created by the steam.

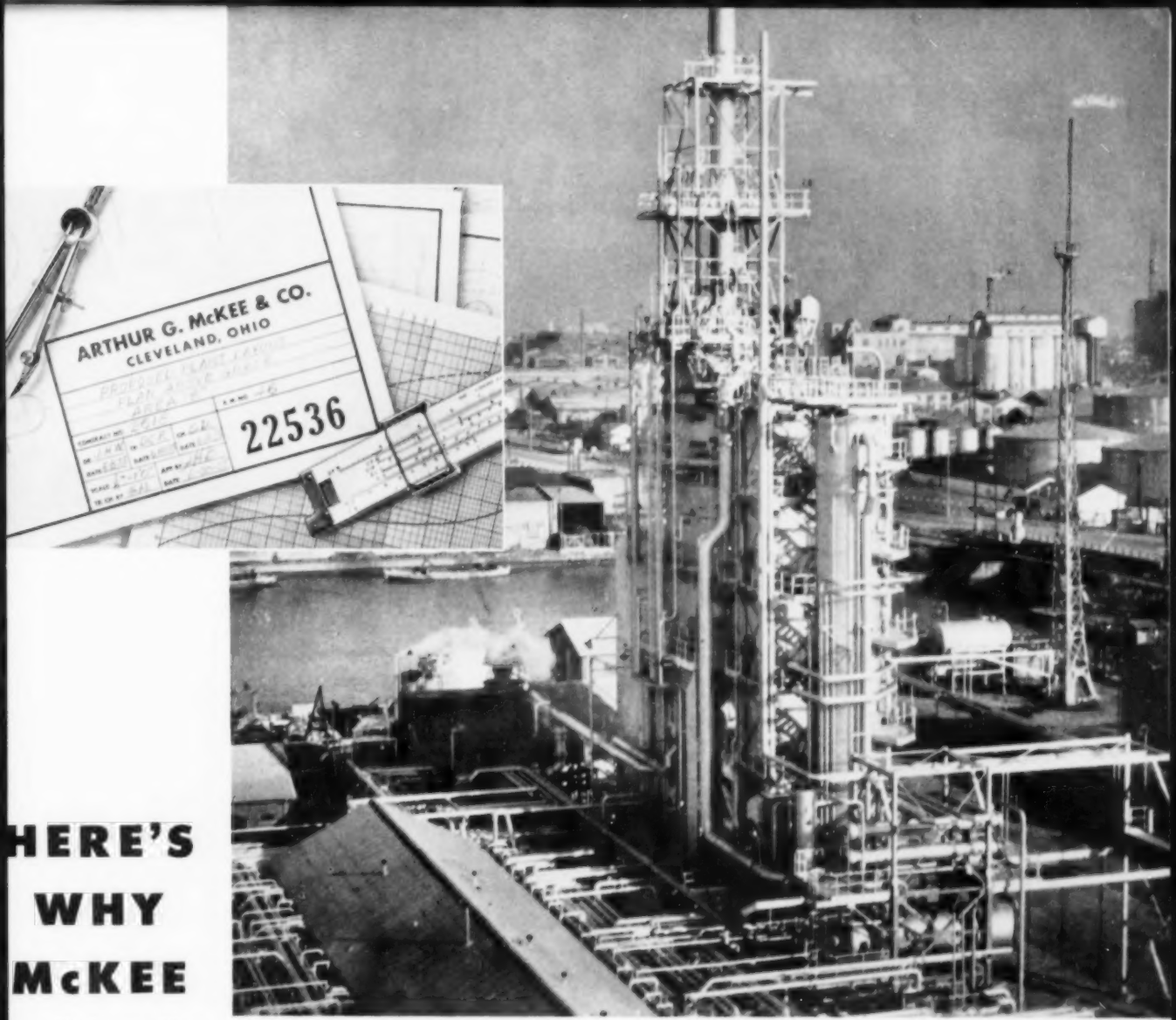
A sealed rotary joint allows the forward end of the gun to revolve at any desired angle, while the handle and hose connections remain stationary. The design of the gun places the thrust of the steam between the two handles to reduce operator fatigue.

Weighing 6¼ lb. and measuring 3½ ft. long, the smaller model needs only a source of 30 psi steam and a 50-gal. drum for the solution. (The larger model is 5 ft. long.) Corrosion-resistant materials are used throughout —aluminum handle, brass valves, stainless steel tubes and nozzles, and an oil-resistant rubber grip. **Oakite Products, Inc.,** 19 Rector St., New York 6, N. Y.

Circle No. **25** *on Reply Card*

Refractory Linings

. . . **that are monolithic** can be made with two new castable products, SK-7 and KS-4—both designed for gun application. SK-7 is a light-weight material (87-92 lb./cu. ft. as applied, 53-58 lb. after firing at 1500° F.), and KS-4 a dense, abrasion-resistant material (133-138 lb./cu. ft. as applied, 118-123 lb. after firing). SK-7 is recommended for maximum tem-



HERE'S WHY McKEE

"builds your plant on paper"

before we build it on the site . . .

● A half-century of experience has shown us (and our hundreds of customers) the value of thorough, painstaking engineering of projects like yours. We know that meticulous care and accurate thinking-through of every detail of design and engineering pays off for you in dollars and cents.

Good engineering drawings speed up construction, save man-hours in the field and avoid changes during construction. But, most important of all, this superior brand of engineering by McKee gives you what you want for your money — a better plant, designed and built to earn a profit.

McKee Engineering Services

Arthur G. McKee & Company • Engineers and Contractors
Headquarters: McKee Building • 2300 Chester Avenue • Cleveland 1, Ohio
Offices: New York, N. Y. • Union, New Jersey • Washington, D. C.
British Representatives of Metals Division: Head, Wrightson & Co., Limited
Canada: Arthur G. McKee & Company of Canada, Ltd., 372 Bay St., Toronto

CAPACITY for QUALITY

IN TODAY'S GREASE MANUFACTURE

PATTERSON
GREASE MIXERS

Patterson Grease Kettles and Mixers lead the field in heavy lubricant production. Equipped with heavy duty, double motion drive and efficient clean-scraping stirrers. Let us explain the many advantages to you!

Richard L. Cameron
President

Top Entering Mixers

Grease Kettles

Side Entering Mixers

Give outstanding performance in blending, sweetening and ethylizing of gasoline, blending of oils, etc.

The Patterson Foundry and Machine Company
East Liverpool, Ohio, U. S. A.
NEW YORK, BOSTON, BALTIMORE, PHILADELPHIA, PITTSBURGH, DETROIT, CINCINNATI, ATLANTA, CHICAGO, ST. LOUIS, HOUSTON, DENVER, LOS ANGELES, SAN FRANCISCO, SEATTLE
The Patterson Foundry and Machine Company, (Canada) Limited
Toronto, Canada
MONTREAL

peratures of 1800° F., KS-4 for 2550° F. Modulus of rupture when fired at 1000° F. is 250-400 psi. for SK-7, 800-1200 psi. for KS-4. Thermal conductivity is 1.88 Btu/sq.ft./hr./°F./in. thickness at 1200° F. mean temperature for SK-7, 4.53 Btu for KS-4. Recommended for monolithic, composite linings of large and unusually shaped vessels of furnaces. Both materials may also be slap-trowelled or poured in forms. **A. P. Green Fire Brick Co.,** Mexico, Mo.

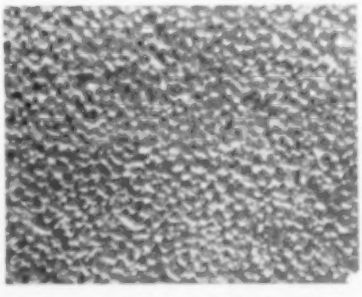
Circle No. **26** *on Reply Card*

Welded Aluminum Chain

. . . **is non-sparking** and has excellent resistance to corrosion.

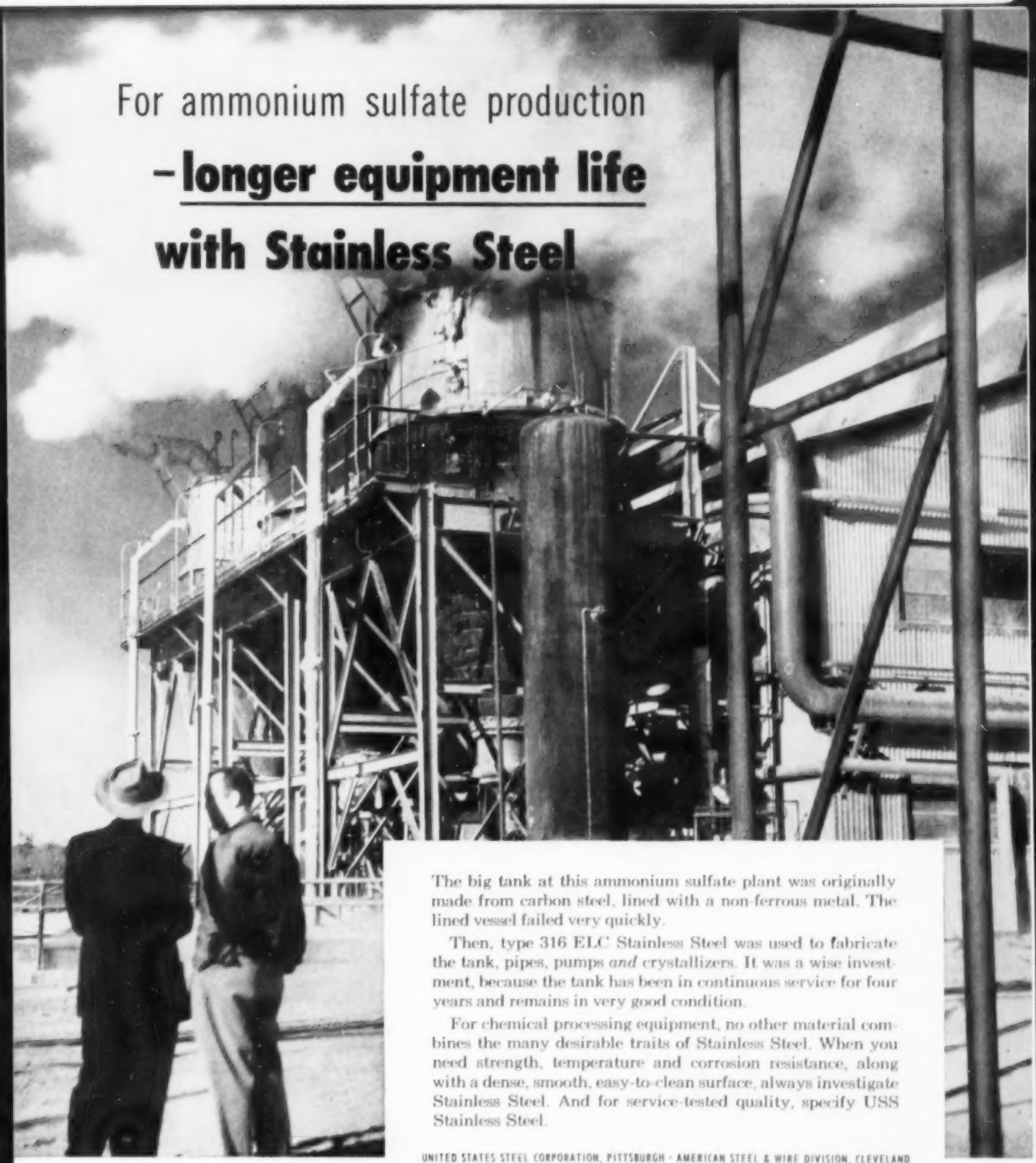
This lightweight chain has 60% the strength of comparable welded steel and weighs 65% less than steel chain. It is available in ¼-, 5/16-, ⅜-, and ½-in. sizes. Satisfactory welding of aluminum chain, with joints as strong as the metal itself, is the result of research and experiment by the manufacturer. **McKay Co.,** 373 McKay Bldg., Pittsburgh 22, Pa.

Circle No. **27** *on Reply Card*



Porous Stainless Filters

. . . **operate under severe conditions:** temperatures to 1200° F., pressures of



For ammonium sulfate production

–longer equipment life with Stainless Steel

Lion Oil Company, Chemical Division, El Dorado, Ark.

The big tank at this ammonium sulfate plant was originally made from carbon steel, lined with a non-ferrous metal. The lined vessel failed very quickly.

Then, type 316 ELC Stainless Steel was used to fabricate the tank, pipes, pumps *and* crystallizers. It was a wise investment, because the tank has been in continuous service for four years and remains in very good condition.

For chemical processing equipment, no other material combines the many desirable traits of Stainless Steel. When you need strength, temperature and corrosion resistance, along with a dense, smooth, easy-to-clean surface, always investigate Stainless Steel. And for service-tested quality, specify USS Stainless Steel.

SEE The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

UNITED STATES STEEL CORPORATION, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO · NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

USS

9-2474

UNITED STATES STEEL

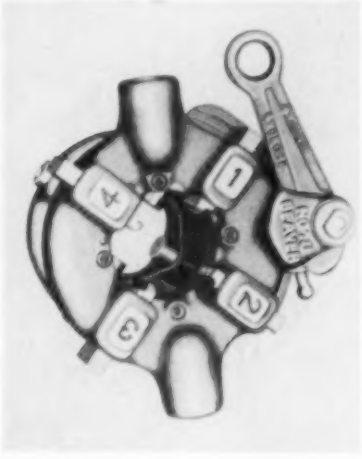
SEND FOR PSC
BUBBLE CAP BULLETIN 22
300 Styles Furnished Without Die Cost
This standard reference on bubble caps and risers contains complete specification information for hundreds of variations. Also many drawings for use in determining methods of tray assembly. With dies on hand for all listed styles, PSC can save you substantial die costs as well as design and delivery time. Furnished in any drawing type of metal, to meet your coking or corrosion problems. Assemblies will also be produced to your specifications.
PSC
THE PRESSED STEEL CO. • Wilkes-Barre, Pa.

2000 psi, and with corrosive liquids or gases.

Produced from spherical powdered stainless steel alloys, the filter elements are available in either cylindrical or cell type shapes. For unusual conditions, custom engineered filters are available from this material.

The "Poro-Klean" elements have the following properties: tensile strength (ultimate) 9000 to 25,000 psi; % elongation, 3 to 6%; and per cent of porosity, 30 to 50%. Particle size retention grades from 3 to 30 microns. **Cuno Engineering Corp.**, Meriden, Conn.

Circle No. **28** *on Reply Card*



Quick-Opening Threader

. . . **has no lead screw,** and dies can be set or reset instantly.

A quick-opening die throw-out retracts the dies when opened, and eliminates the need for backing off finished threads. When the handle is closed for the succeeding thread, the setting remains in position. Alignment is obtained without clamping. The Beaver "78" can be used with any power drive.

Threads of 1-, 1¼-, 1½-, and 2-in. are made with one set of full-width high speed dies. **Beaver Pipe Tools, Inc.,** Warren, Ohio.

Circle No. **29** *on Reply Card*

Platforming Catalysts

. . . **tailored for producing gasolines** of 98 leaded octane number and higher are now available.

"UOP Type R-7 and Type R-8," the improved catalysts, are of low density and high activity. Their shape is spherical, but smaller in size than the present line of catalysts. In the production of high octane number of gasolines,

H&B ESTABLISHED 1907

At left: Jacketed 3-Way Plug Cock.

Below: Cutaway section of Jacketed Cock, showing packing gland construction.

Jacketed Pipe, Pumps, Valves and Fittings . . .

Jacketed Motor, with set-back register, for measuring viscous liquids.

for maintaining uniform temperatures (hot or cold) in process pipes

Regardless of whether the material is being heated or cooled in the processing, and what heating or cooling medium is being used, H & B jacketed fittings are available for all applications. Steam, hot water or hot oil may be used for heating, cold water or brine for cooling.

H & B can save you money on your jacketed pipe and fitting requirements because we buy all standard size pipe from the mill in carload lots, make our own special flanges in quantities, and are tooled up for making jacketed equipment at lowest possible price. Write for Bulletin J-50.

HETHERINGTON & BERNER INC.
715 KENTUCKY AVE. INDIANAPOLIS 7, IND.

Once is not enough!

The need for blood is greater than ever, not only for men wounded in combat, but here at home . . . to cure disease, to meet accidents and disasters, and to prepare for civil defense.

Our quota can ONLY be met, if those who give *keep on* giving . . . regularly!

You CAN give more than once . . . as often as every three months with complete personal safety. The more often you give the more often you save a life. For every pint of blood you give goes to someone who needs it desperately.

Remember . . . once is NOT enough. Give blood again and again! Call your Red Cross, Armed Forces or Community Blood Donor Center for an appointment to give blood today.

GIVE BLOOD

...give it again and again

BUSINESS EXECUTIVES!

CHECK THESE QUESTIONS

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ◯ HAVE YOU GIVEN YOUR EMPLOYEES TIME OFF TO MAKE BLOOD DONATIONS?
- ◯ HAS YOUR COMPANY GIVEN ANY RECOGNITION TO DONORS?
- ◯ DO YOU HAVE A BLOOD DONOR HONOR ROLL IN YOUR COMPANY?
- ◯ HAVE YOU ARRANGED TO HAVE A BLOOD-MOBILE MAKE REGULAR VISITS?
- ◯ HAS YOUR MANAGEMENT ENDORSED THE LOCAL BLOOD DONOR PROGRAM?
- ◯ HAVE YOU INFORMED EMPLOYEES OF YOUR COMPANY'S PLAN OF CO-OPERATION?
- ◯ WAS THIS INFORMATION GIVEN THROUGH PLAN BULLETIN OR HOUSE MAGAZINE?
- ◯ HAVE YOU CONDUCTED A DONOR PLEDGE CAMPAIGN IN YOUR COMPANY?
- ◯ HAVE YOU SET UP A LIST OF VOLUNTEERS SO THAT EFFICIENT PLANS CAN BE MADE FOR SCHEDULING DONORS?

Remember, as long as a **single** pint of blood may mean the difference between life and death for **any** American . . . the need for blood is **urgent!**

NATIONAL BLOOD PROGRAM

 (To obtain more data on advertised products see page 126)

CONSECO SERVICE.... as near as your telephone

When your heat exchanger, condenser or other tubular equipment suddenly quits . . . it's AN EMERGENCY. You spin your phone dial . . . *and in minutes, day or night, Sundays or holidays, a CONSECO REPAIR CREW is speeding to your plant.* Expert, fast, doing in hours what otherwise would take days . . . they're equipped with special tools and all the tubes, tube sheets or specialties you need, drawn from our complete stock. Yes, CONSECO SERVICE is as near as your telephone. Call our Maintenance Department.

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

164 Observer Highway
Hoboken, N. J.

• *Send for Bulletins giving complete engineering data on these products.*

EQUIPMENT DESIGNED AND BUILT BY CONSECO

HEAT EXCHANGERS • CONDENSERS • EVAPORATORS • STEAM JET AIR EJECTORS • STEAM GENERATORS • PRESSURE VESSELS CENTRIFUGES • FILTERS and STRAINERS • PUMPS, INSTRUMENTS, SPECIALTIES

they are reported to give increased yields, with more hydrogen and less carbon than presently available catalysts. Type R-8, available under special arrangement, has a higher platinum content. **Universal Oil Products Co.,** Des Plaines, Ill.

Circle No. **30** *on Reply Card*

Pressure Transducer

. . . **converts readings to electrical output,** as well as displaying the value on the front of instrument case.

The "Digital Press-I-Cell" senses pressure by means of two "Ni-Span C" capsules, motion of which is detected by a differential transformer-type pick-up coil. A servo-operated follow-up mechanism magnifies the signal. The unit's output may be in the form of electrical signals permitting remote transmission in pulse form, direct operation of digital readout equipment, or continuous control of servo follow-up systems. The actual value of the measured pressure appears in front of a fixed line on the calibrated film strip. **Fischer & Porter Co.,** Hatboro 35, Pa.

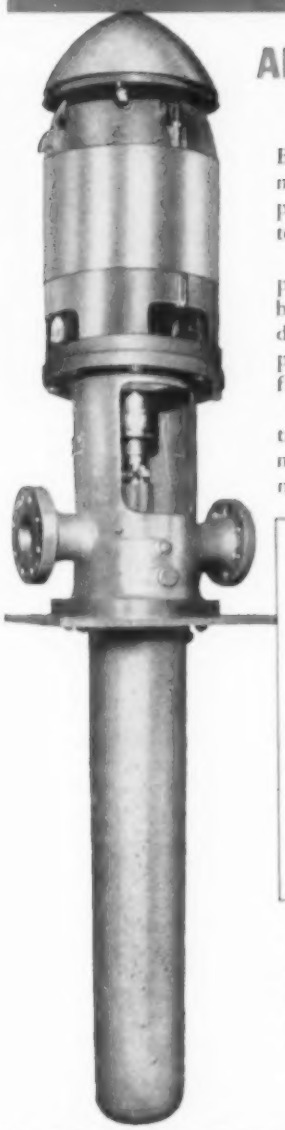
Circle No. **31** *on Reply Card*

Emergency Lighting Unit

. . . **uses hermetically sealed nickel-cadmium battery,** which requires no additional liquid for a guaranteed lifetime of 10 years.

The emergency unit provides full illumination if normal power is dis-

NEW! Bingham VCP VERTICAL PUMP FOR LOW NPSH



ALL WORKING PARTS ACCESSIBLE WITH BOTTOM DISMANTLING

Besides bottom dismantling, which in itself greatly reduces maintenance time when attention is required, this new Bingham pump incorporates advanced features which minimize maintenance, reducing need for periodic inspection.

For example, all intermediate bearings (supplied of appropriate material for different pumpages) are forced-lubricated by pumpage. Bottom bearing is lubricated, even if pump runs dry for short periods. This *dependable* lubrication greatly prolongs life of bearings, which in conventional pumps are frequently the cause of maintenance shutdowns.

Wherever installed, the Bingham VCP Pump has given trouble-free service—plus unsurpassed smooth operation with no vibration. Available for any capacity or head. Write your nearest Bingham office for additional information.

ONLY Bingham OFFERS ALL THESE BENEFITS:

1. Heavy-duty steel suction and discharge head rigidly built to eliminate vibration caused by drivers.
2. Shaft is maximum diameter throughout.
3. Shafts are equipped with renewable 11-13 chrome, hardened, ground and polished sleeves at each bearing.
4. Bearings are of the appropriate material for the different pumpages.
5. Maximum head per stage and maximum efficiency for a given capacity range.
6. Front and back wearing rings on enclosed type impellers permit a one-stage pressure drop over each bearing for lubrication purposes.
7. Wear rings reduce thrust of rotating element, permitting use of standard motors.
8. Maximum eye area of bottom impeller for lowest possible NPSH.
9. Bottom bearing lubricated by pumpage taken from the discharge column, which, together with connecting pipe, acts as a reservoir for bearing lubrication in event pump operates "dry" for short periods.

All working parts of pump easily accessible with bottom dismantling. One man can service after lifting pump from well. By dismantling from bottom, repair or replacement of any part can be made in much less time than with conventional pumps (where dismantling begins from top, necessitating removal of driver and head before pump unit is accessible).

Various operators estimate that time required to reach working parts has been reduced as much as 50%.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY

General Offices: **2800 N.W. Front Avenue, Portland 10, Oregon**

Factories: **Portland, Ore. • Vancouver, B.C., Canada**

SALES AND SERVICE OFFICES

BOSTON, MASS.
CHICAGO, ILL.
DENVER, COLO.
HOUSTON, TEXAS
KANSAS CITY, MO.
NEW ORLEANS, LA.
NEW YORK CITY, N.Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CALIF.
SEATTLE, WASH.
ST. LOUIS, MO.
ST. PAUL, MINN.
TULSA, OKLA.
TORONTO, ONT., CAN.
VANCOUVER, B.C., CAN.

A Special New Product!

PRODUCED BY THE TENNESSEE CORPORATION, MINERS OF COPPER, ZINC, IRON AND SULFUR.

CUPRIC CHLORIDE

For Removal of Sulfur Compounds in Petroleum Refining.

CONTRACT REQUIREMENTS SOLICITED . . .
We are in a position to supply your needs on annual, semi-annual, or monthly contract basis—also smaller quantities in drop shipment lots.

CUPRIC CHLORIDE DI-HYDRATE — TC TENNESSEE CORPORATION

TYPICAL ANALYSIS

Copper	37.00%	Minimum
Moisture	12.00%	Maximum
Fe	.04%	Maximum
Zn	.01%	Maximum
Water Soluble	more than 99.50%	
Insoluble as copper oxychloride	less than .50%	

FOR
1. Quality Improvement
2. Cost Reduction

Other Tennessee Corporation products, Ferric Sulfate (Ferri-Floc), Copper Sulfate, and Sulfur-Dioxide.

For Samples . . . Make request on your company letterhead.

CHECK THESE *FEATURES:*

√	HIGHER COPPER CONTENT
√	LOWER MOISTURE
√	FINER PARTICLE SIZE
√	UNIFORMITY
√	AVAILABILITY

TENNESSEE TC CORPORATION

617-29 Grant Building, Atlanta, Georgia

You'll Want a REPRINT for your own files of
"It's Time to Take a New Look at
CATALYTIC REFORMING"
the special 48-page report from the August 1955 issue of
Petroleum Processing
Single copies—$0.75, postpaid

Send orders to:
Reader's Service Dept.
Petroleum Processing
330 West 42nd Street
New York 36, N. Y.

OR

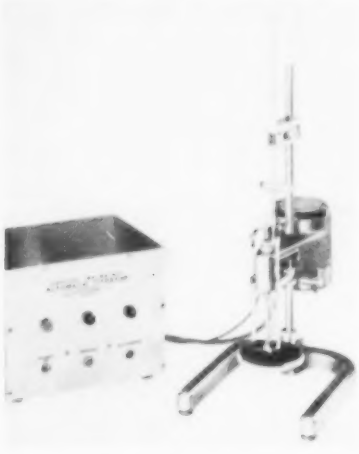
There's a new, easy way to order single copies of this reprint. Circle number "R3" in Area "C" of the Reader's Service Card in this issue—pages 127-128.

(New York City residents, add 3% city sales tax)

rupted, and automatically recharges itself when normal power is restored. It can be recharged over 1000 times without essential loss of power, and can be stored indefinitely in either charged or discharged condition.

Due to the nickel-cadmium battery the unit is small in size: 17 x 7 x 11½ in. Its weight is 13.5 lb. The unit will operate from 25 degrees below zero to 145 degrees above zero F. **Dynaseal Lighting Corp.,** 5 Hadley St., Cambridge 40, Mass.

Circle No. **32** *on Reply Card*

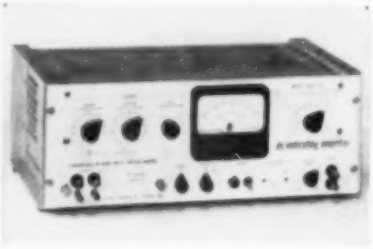


Automatic Titrator

. . . **determines the end point** and shuts off the burette valve by itself.

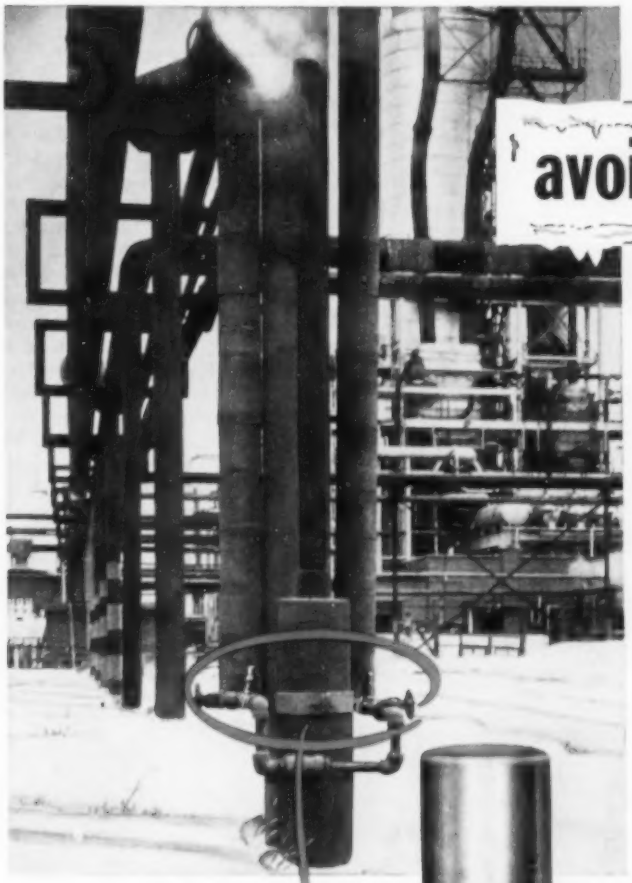
This new instrument requires no preselection of voltage to determine the end point. The cell potential is amplified, differentiated, and filtered to produce a signal of sufficient strength to close the burette valve. This new procedure is said to be more accurate and quicker than present methods of automatic titration and is based on H. V. Malmstadt's second derivative method for potentiometric titration. **E. H. Sargent & Co.,** 4647 W. Foster Ave., Chicago 30, Ill.

Circle No. **33** *on Reply Card*



D-C Amplifier

. . . **has wide application** for corrosion



avoid freeze-ups

. . . use Yarway impulse steam traps

Don't take chances with equipment freeze-ups and costly production delays. Put Yarway Impulse Steam Traps on all lines subject to freezing temperatures.

There's no danger of your lines freezing with Yarway traps. Condensate does not collect. The only moving part of the trap—a little valve—continually tests for condensate, discharges each bit as it forms.

Besides this non-freezing feature, plant men like these other Yarway Impulse advantages:

- Body and all working parts are stainless steel
- Gets equipment hot in a hurry and keeps it hot
- Small size . . . light weight
- Easy to install . . . easy to service
- Good for all pressures
- Low initial cost

Over 250 Industrial Distributors stock and sell Yarway Impulse Steam Traps and Fine Screen Strainers. For name of one near you and free trap booklet, write . . .

YARNALL-WARING COMPANY
153 Mermaid Ave.
Philadelphia 18, Pa.

This little valve, the only moving part, actually floats on the condensate load, discharges each bit of condensate as it forms—gets equipment hot in a hurry and keeps it hot.

YARWAY impulse® steam traps

LINDBERG LABORATORY HOT PLATES

BOILING? EVAPORATIONS? HEATING?

Whatever your need may be you can fill it perfectly with one of these Lindberg Hot Plates.

Model H-2—(illustrated)—Plate working surface 12" x 20". Power rating 2600 watts. Power service 115-230 v. 50/60 cycle. 950° F. maximum temperature.

Model H-1—Plate working surface 10" x 12". Power rating 1300 watts. Power service 115-230 v. 50/60 cycle. 950° F. max. temperature.

Model H-3—Plate working surface 12" x 30". Power rating 3900 watts. Power service 230 v. 50/60 cycle. 950° F. max. temperaure.

Model H-5—Plate working surface 5" x 22". Power rating 1300 watts. Power service 115-230 v. 50/60 cycle. 950° F. max. temp. Four clamp sockets accommodate standard dovetail support clamps.

This new low cost Lindberg Pyrodisc is the ideal portable hot plate for the user whose volume of hot plate work is limited. Top plate 8" diameter. Power rating 660 watts. Power service 115 v. 50/60 cycle. 750° F. Maximum Temperature.

All Lindberg Hot Plates offer many exclusive features, and are available for immediate shipment. Order from your laboratory equipment dealer, or for additional information, ask us to send you Bulletin No. 1001-A.

LINDBERG LABORATORY DIVISION
Lindberg Engineering Company
2481 West Hubbard Street, Chicago 12, Illinois

research, electrochemical, and biophysical measurements. It has an imput impedance of over 1 million megohms, a maximum gain of 160,000 and a frequency response to 100 kc.

The unit includes an accurate meter with ranges of 2 to 2000 millivolts full scale, a power amplifier for driving all common direct-writing recorders, and a zero drift of less than two millivolts/hr. on any range or gain setting.

Input terminals are mounted on a small plug-in panel which can be interchanged with plug-in multipliers that extend the voltage range to 800 volts full scale, or a plug-in decade shunt that converts the instrument to a direct-reading micro-ammeter.

The amplifier will measure voltages as low as 200 microvolts, currents down to 10^{-12} amperes, and resistance up to 10^{14} ohms. It can also measure transistor, piezoelectric crystal, and capacitor potentials—as well as currents in semi-conductors, photocells, and ion chambers. **Keithley Instruments, Inc.,** 3868 Carnegie Ave., Cleveland 15, Ohio.

Circle No. **34** *on Reply Card*

X-ray Inspection Unit

. . . **combines tube and generator** in one housing, eliminating the need for high tension cables.

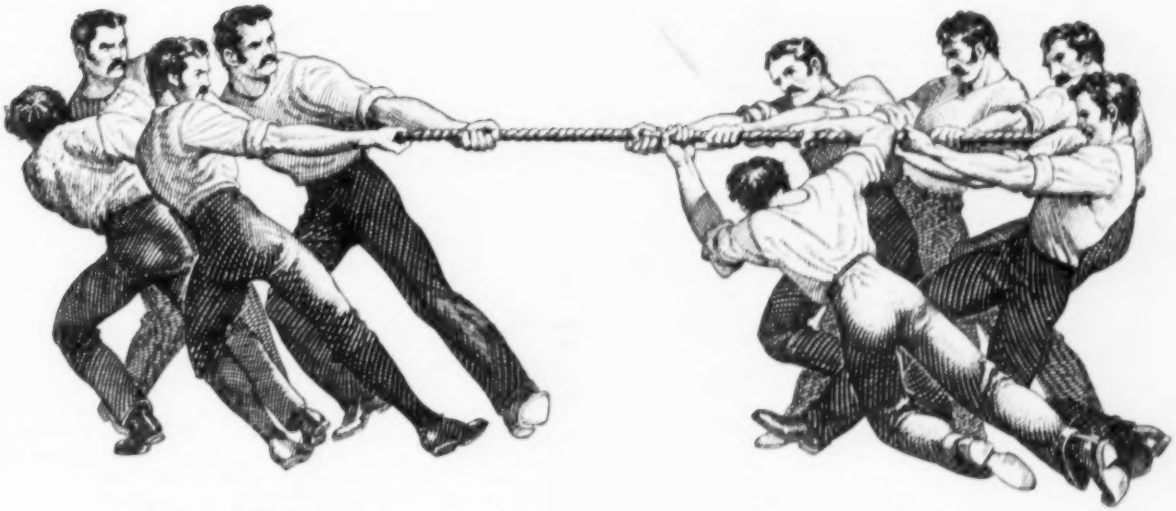
The Norelco MG 160-D unit provides either 40-degree or 120-degree apertures for rapid inspection of welds, pipe lines, or equipment. The new design tubehead provides a 1.5 mm focal spot, a rotable indexing radiation diaphragm, and two apertures 180-degrees apart. A locking device fixes either aperture in position for use; a red line indicates the tube focus position.

The high tension generator mounted within the 143-lb. tubehead creates 160,000 volt output. The tubehead measures 39 in. long and 8¼ in. in diameter, with handles 11½ in. The

boost production

with the Ljungstrom® Air Preheater

4 *of your units can do the work of* 5

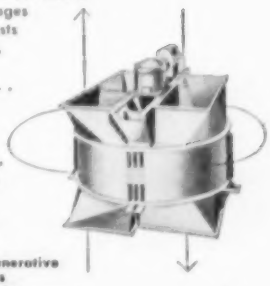


HOW FAST IS "WRITE OFF"?

In most cases, the Ljungstrom installation is quickly written off by increased capacity alone. Write-off time is even less when the other Ljungstrom advantages are considered — saves up to 20% of fuel costs . . . permits more economical furnace design, with no need for convection surfaces . . . burns many fuels you used to throw away . . . results in consistently higher through-put . . . and minimizes slag.

For more complete details on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits attainable in fuel burning equipment — call or write The Air Preheater Corporation.

Wherever You Burn Fuel, You Need Ljungstrom



The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

Recover waste heat, return it to the furnace as combustion air, and you naturally generate higher flame temperatures . . . increase heat-transfer rates — *which means more through-put.*

That's why four of your present processing units can do the work of five *with Ljungstrom Air Preheaters increasing each unit's output as much as 25%.* One eastern refinery increased the continuous capacity of a pipe still from 16,000 to 18,000/20,000 barrels a day — by modernizing and including a Ljungstrom.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

It's Tops

...for quick clean cuts

7 cutters for ⅛" to 6" pipe.

...the efficiency-balanced

RIDGID

Heavy-Duty Pipe Cutter

Powerfully built—guaranteed not to warp or break, always tracks perfectly . . . Famous RIDGID thin-blade or heavy-duty cutter wheels of tool steel roll easily, cleanly through any pipe.* Every cutter factory-tested! Buy them at your Supply House.

*Special wheels available for stainless steel and cast iron.

For fast easy pipe cutting in tight places,
RIDGID 4-wheel cutters.

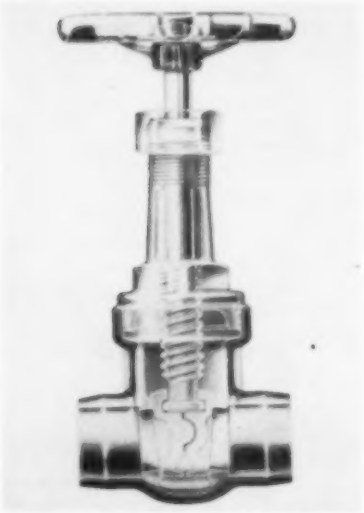
RIDGID
Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U.S.A.

power supply is 230 volts a.c. and uses 10 amperes.

The stepless control for the unit weighs 99 lb., and has a built-in time totalizer which permits selection of voltages from 75 to 160 KV at currents of 6 ma. maximum. **North American Philips Co.,** Research and Control Division, 750 South Fulton Ave., Mount Vernon, N. Y.

Circle No. **35** *on Reply Card*



Solder-End Valves

. . . **for use with copper tubing**—a new line of bronze valves available from Lunkenheimer Co.

Included are three gate valves: rising stem with double-wedge disc, rising stem with a solid-wedge disc, and non-rising stem with single-wedge disc. All are rated at 125 psi steam and 200 psi water, oil or gas. A bronze swing check valve with same pressure rating has renewable disc and side plugs. The line is completed by a non-metallic-disc globe valve, rated at 150 psi steam and 300 psi water, oil, and gas.

These new valves are identical with the manufacturer's screw-end valves, except for the attaching ends. They are designed with plain ends for use with types K, L, and M copper tubing. **Lunkenheimer Co.,** P.O. Box 360, Cincinnati 14, Ohio.

Circle No. **36** *on Reply Card*

Electronic Level Control

. . . **eliminates moving parts** in the liquid.

The "Belmont" liquid level control consists of three parts: main control unit, the sensing element, and a coaxial cable connecting the two. The

NEUTRAL
NONREACTIVE
HIGHLY REFRACTORY

Alcoa Tabular Alumina Balls

for CATALYST, REACTOR,
DESICCANT BED SUPPORTS AND COVERS

ALCOA Tabular Alumina Balls T-162 in ¼-inch, ⅛-inch, ½-inch and ¾-inch diameters are used as desiccant and catalyst bed supports or covers where exposed to high temperature, severe corrosive or erosive conditions. High chemical purity and inertness make contamination negligible.

ALCOA Tabular Alumina Balls T-164 available in ¼-inch and ⅜-inch diameters are more resistant to thermal and mechanical shock. They are suitable for pebble heaters and similar severe operations requiring high heat capacity and conductivity.

For additional information and samples, write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 716-A Alcoa Building, Pittsburgh 19, Pennsylvania.

PROPERTIES OF TABULAR ALUMINA BALLS

Chemical Analysis
Al_2O_3 ..... 99.5+%
Mean Specific Heat (Btu/lb/°F)
74°F to 212°F 0.200
74°F to 932°F 0.233
74°F to 1832°F 0.244

BALL SIZES AND WEIGHTS

Nominal size, inch	Passes screen opening, inch	Retained on screen opening, inch	Approximate: Balls per pound	Approximate: Pounds per cu ft
¼	0.371	0.263	670	128
⅜	0.525	0.371	202	126
½	0.624	0.525	72	125
¾	0.883	0.742	27	125

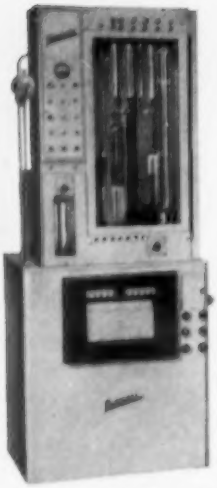
ALCOA Tabular Alumina Balls are high purity alumina (sintered corundum). Produced at temperatures above 3000°F, these balls have a softening point well above 3500°F. Unaffected by both oxidizing and reducing atmospheres at temperatures below the softening point, they are practically insoluble in all aqueous acid and alkaline solutions.

ALCOA CHEMICALS
ALUMINUM COMPANY OF AMERICA

BURRELL "For Scientists Everywhere"

THE FRACTON®

FOR ANALYSIS OF
LIGHT HYDROCARBONS



For: NATURAL GAS
GASOLINE PLANT GASES AND LIQUIDS
REFINERY GASES
CYCLING PLANT GASES
LIQUEFIED PETROLEUM GASES
SYNTHETIC RUBBER INTERMEDIATES
PLASTIC INTERMEDIATES
PETROCHEMICAL GASES
and other light hydrocarbons

THE FRACTON CUTS ANALYSIS TIME AND EXPENSE, IMPROVES ACCURACY AND IS EASIER TO OPERATE

The Fracton separates, identifies, collects and measures the components and records the analytical data in fifty to seventy-five percent less time than former methods. Users get superior accuracy and reproducibility with this new, improved and simplified instrument.

Request Your Copy of Booklet No. 82

Trademark

BURRELL CORPORATION
Scientific Apparatus and Laboratory Supplies
2223 Fifth Avenue, Pittsburgh 19, Pennsylvania

PHOENIX *Drop-Forged* FLANGES MEAN...

MAXIMUM STRENGTH

Long life is assured with Phoenix maximum strength flanges. Forged of mild steel, they are available in a wide range of styles and sizes. Meet ASA requirements and ASME and ASTM specifications.

NEW CATALOG!
Send for free brochure showing Phoenix Complete Line.

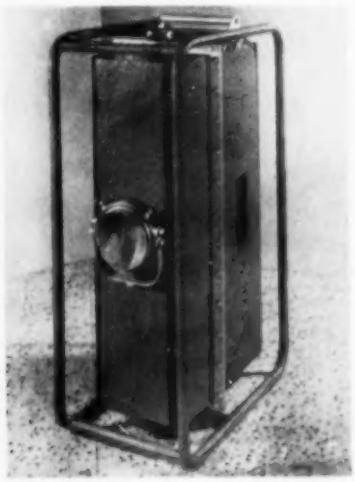
FLANGE DIVISION
PHOENIX MANUFACTURING CO.
Catasauqua, Pa. • Joliet, Ill.

length of the cable can be as much as 1000 ft.

The sensing element is a capacitance probe which measures the difference in the capacitance of different liquid levels. The value is transmitted to an electronic tube that amplifies the signal many thousands of times. The amplified electrical force actuates a relay, a meter, or a pneumatic pilot—which in turn may actuate a solenoid valve, a pump, or other electrical system used in controlling the liquid level in a process vessel.

Two control knobs allow easy adjustment. The differential knob adjusts the level between the cut-in and cut-out points; the level control knob establishes the final liquid level to be maintained. **Fisher Governor Co.**, Marshalltown, Iowa.

Circle No. **37** *on Reply Card*



X-ray Metal Inspector

. . . **features low weight-to-power ratio,** and comes in three sizes.

The lightest unit weighs 46 lb. and provides power penetration of 140 KVP—enough to penetrate 1½ in. of steel, or its equivalent. With cables, the Baltospot fits inside a trunk 32 x 16 x 13½ inches.

The "Baltograph 180" is designed for reaching difficult locations. Rated at 180 KVP and weighing 119 lb., this X-ray head can be equipped with a tube for 360° radiation. It is also possible to substitute an angle target tube giving an output of 10 ma. with an inherent filtration of ⅛-in. beryllium.

The largest unit (pictured above) is

Circle No. **38** *on Reply Card*

"Soyez les Bienvenus à Montréal au Mois de Mai!"

INTRODUCING . . .

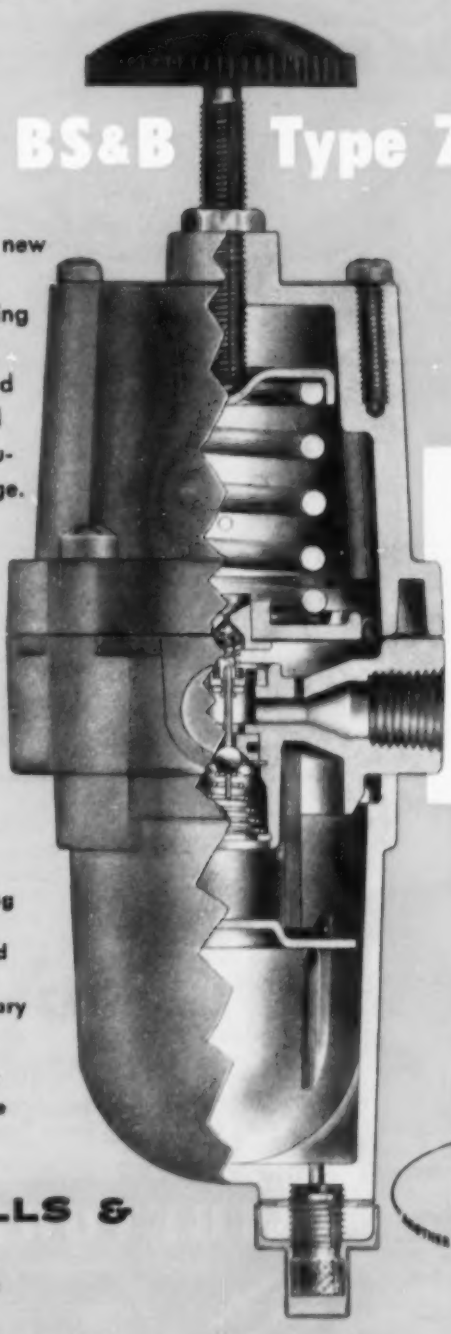
Today's Finest Instrument Air Regulator!

It's The New BS&B Type 73-26!

We invite your comparison of the new BS&B Type 73-26 Instrument Air Regulator with any other make being offered today. When you've seen the differences and have compared performance data, we know you'll agree the 73-26 is the *finest* instrument air regulator in its price range.

FEATURES

- Higher Air Volumes.
- Improved Corrosion Resistance.
- 40 Micron Phenolic Impregnated Cellulose Filter.
- Minimum Pressure Drift From Set Point.
- Instantaneous Response To Changes In Flow Rate.
- Easy Adjustment To Within Close Limits For Any Pressure Within Its Output Range.
- Can Be Serviced Without Removing From Air Line.
- Can Be Panel Or Bracket Mounted If Desired.
- Available With Or Without Auxiliary Pressure Gauge.



1/4" Pipe Connections

40 PSI — Maximum Reduced Pressure (100 PSI with Special Spring)

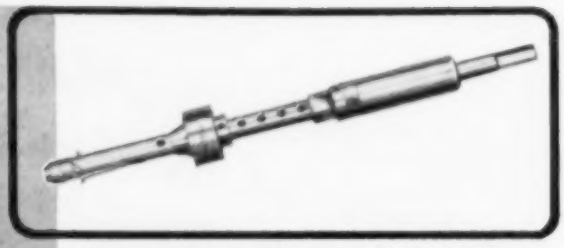
300 PSI — Maximum Input Pressure

10 CFM — Maximum Capacity

For complete information, contact your BS&B Representative, or communicate directly with . . .

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-DI
7500 East 12th Street, Kansas City 26, Missouri

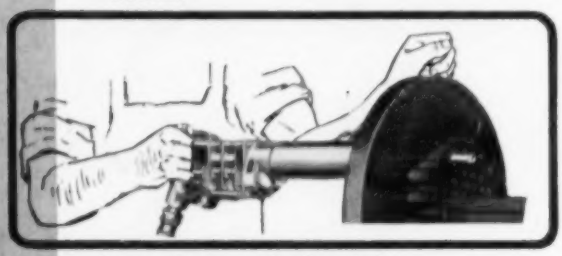


Now—a new push-type internal Tube Cutter

A time-saving maintenance tool that may be used with your present air or electric motor to cut non-ferrous tubes.

Easily carried. A must in every tool box.

Many uses in every plant. Action of cutting blades is produced by pushing cutter into the tube which automatically opens the double cutter blades.

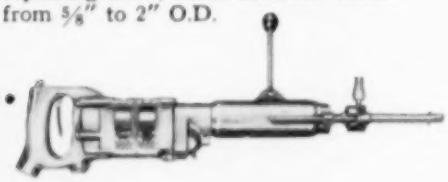


Works wonders when replacing tubes

Extremely useful. Saves time when replacing worn, small diameter tubes from ⅝" to 2" O.D.

Also furnished with motor and lever operator

An air-driven type internal tube cutter is available for production use. Cuts non-ferrous tubes 2-4 seconds each. Steel tubes 8-12 seconds each. Literature and complete details upon request.



"There's an Airetool Tube Cleaner and Tube Expander for Every Type of Tubular Construction."

BRANCH OFFICES: New York, Chicago, Philadelphia, Tulsa, Houston, Baton Rouge.

Representatives in principal cities of U.S.A., Canada, Mexico, England, South America and Japan.

EUROPEAN PLANT: Airetool Nederland, N.V., Vlaardingen, The Netherlands.

AIRETOOL

MANUFACTURING COMPANY

SPRINGFIELD, OHIO

rated at 260 KVP, and is designed for checking thick, high density metals. The head is completely self contained and shock mounted; its weight is 230 lb. **Balteau Electric Corp.**, Stamford, Conn.

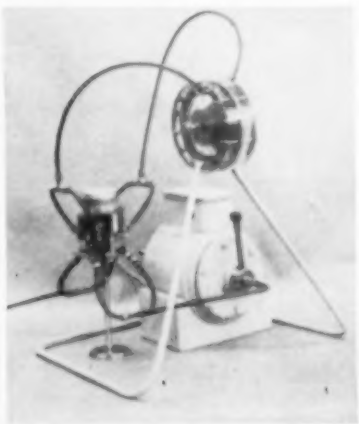
Circle No. **39** *on Reply Card*

Photoelectric Analyzer

. . . **for liquids, vapors, or gases** can be used for process control or pollution monitoring.

"Model III" automatically records quantities of gas or vapor in the air, down to a few parts per billion. It will detect such substances as mercury, naphthalene, xylene, sulfur dioxide, bromine, nitrobenzine, ozone, benzaldehyde, and many others. This "chemist in a box" periodically and automatically checks and re-sets itself to compensate for any smudge accumulation on cell windows, or other similar sources of error. **Manufacturers Engineering and Equipment Corp.**, Hatboro, Pa.

Circle No. **40** *on Reply Card*



Downhill Pumps

. . . **accurately meter liquids or gases** against negative discharge pressures. These "Minus Delta P" pumps are

NEWPORT NEWS BUILT two 39'-7" horizontal gas scrubbers, such as this, for J. F. Pritchard & Co. They were made of ASTM-A212 Grade B fire box steel, with structural mesh steel interiors.

Gas scrubber made of 2⅞" steel

Newport News builds almost any type of pressure vessel and other heavy process equipment

Here is one of two horizontal gas scrubbers recently built for an operating pressure of 1800 psi at 300 F.

Newport News made both vessels from fire box steel, 2⅞ inches in thickness. We formed and automatically welded this steel into sections having a diameter of only 4 feet.

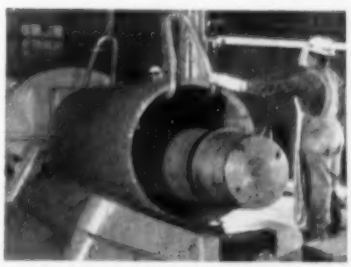
Rolling thick steel to this small diameter...no easy accomplishment, as you probably know . . . demonstrates the sort of jobs Newport News takes in stride.

Almost any type of heavy processing equipment is readily constructed by Newport News in a 225 acre plant comprising huge, fully equipped fabricating and machine shops, foundries, forge and die shops, heat treating and allied equipment as well as complete test facilities.

Newport News shop erection of fabricated units helps to speed assembly at your plant site.

Get a bid from Newport News on your present or future projects. Get the benefit of specialized production techniques. Look over the many ways in which Newport News can help you . . . write for "Facilities and Products", a very interesting booklet. It's yours for the asking.

ENGINEERS Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.



ROLLING 2⅞" STEEL for gas scrubbers. The steel, in a hot condition, was formed on the heavy bending equipment shown here. It will cold roll mild steel up to 3 inches thick, and will hot roll any grade of steel up to a thickness of 5 inches.

Newport News Shipbuilding and Dry Dock Company
Newport News, Virginia

(To obtain more data on advertised products see page 126)

users say Chemiseals pay in longer trouble-free life---

Customers report unsurpassed performance in the following applications.

CONCENTRATED H_2SO_4 ACID	Aurora Pump. 1750 r.p.m. 1 3/16 inch shaft. 2 lbs. suction. 45 lbs. discharge. Temperature of medium 65°C. Not flushed.
UREA-WATER SOLUTION	Ingersoll-Rand Pump. 1750 rpm. 1 1/8 inch shaft. 2 lbs. suction. 35 lbs. discharge. Temperature of medium 100°C. Not flushed.
HYDROCARBON FEED	Labour Pump. 1750 rpm. 1 1/8 inch shaft. 10 lbs. suction, 25 lbs. discharge. Temperature of medium 102°C. Not flushed.
ADIPIC ACID and HYDROCARBON SLURRY	Labour Pump. 1750 rpm. 1 1/8 inch shaft. 35 lbs. suction, 75 lbs. discharge. Temperature of medium 70°C. Seal flushed.
UREA-NH_3 SOLUTION	Ingersoll-Rand Pump. 3600 rpm. 1 1/8 inch shaft. 10 lbs. suction, 50 lbs. discharge. Temperature of medium 75°C. Not flushed.
ESTER (10% Solids)	Byron Jackson Pump. 3600 rpm. 625 lbs. discharge. 30 lbs. suction. Stuffing box pressure 15 lbs. to 65 lbs. Temperature of medium 70°C. Seal flushed.
HYDROXYACETIC and SULFURIC ACID	Allis-Chalmers Pump. 1750 rpm. 1 1/2 inch shaft. 10 lbs. suction, 60 lbs. discharge. Temperature of medium 30°C. Not flushed.

What are your shaft sealing problems? Write for Bulletin MS-1155.

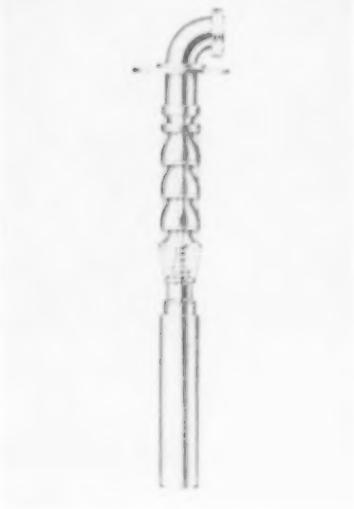
UNITED STATES GASKET CO.
Camden 1, New Jersey

U.S. GASKET · BELMONT PACKING

immune to pressure variations in the system as long as the suction pressure is at least 5 psi above discharge pressure. Capacity is adjusted during operation through stroke length or speed control. A type of leak-proof construction, eliminating any seal or stuffing box, allows safe handling of corrosive materials.

The meter pumps are available in four standard sizes: 3, 15, 75, and 375 ml/cycle. Standard construction material is 316 stainless steel with neoprene or tygon trim. **Milton Roy Co.,** 1300 East Mermaid Lane, Philadelphia 18, Pa.

Circle No. **41** *on Reply Card*



Submersible Booster Pump

. . . **features quiet operation** and little maintenance.

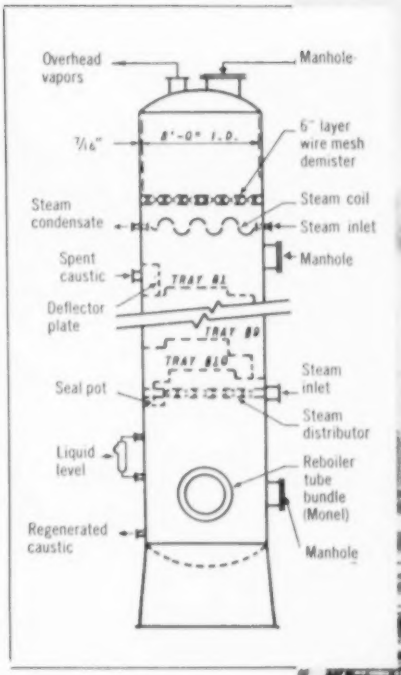
This new line of submersible pumps comes equipped with a General Electric submersible motor, so that the unit is ready for use upon installation without venting, filling, and adjustment. Refinements in the new line include oversize shaft, long bearings with protective caps, perihedral impeller seals, choice of mixed-flow or radial-flow impellers, and a mechanical shaft seal designed for submerged service.

Standard models are available from 5 to 150 hp, with discharge head 50 to 500 ft., and 100 to 4,000 gpm capacity. **Layne & Bowler Pump Co.,** 2943 Vail Ave., Los Angeles 22, Calif.

Circle No. **42** *on Reply Card*

"Soyez les Bienvenus à Montréal au Mois de Mai!"

New solid Monel caustic stripper. Old tower was a conventional Raschig-ring-packed, 9 ft. diam. tower with walls clad or lined to 20 per cent of thickness with Monel nickel-copper alloy. New tower is 8 ft. diam. bubble cap tower with 7/16 in. solid Monel walls and a wire mesh coalescing demister installed above the feed tray. New unit reduces maintenance materially. It eliminates ring dust and reduces caustic carryover, saving about 75,000 lbs. per month. It gives a far "sweeter" product, cutting after-treating reagent use in half. Tower response to process changes is also greatly improved.



New caustic stripper is solid Monel

Cities Service expects big cut in former $20,000 per year average maintenance bill

When a vessel must withstand corrosive 47° Baumé caustic at 290° to 300° F., it needs all the protection it can economically obtain.

That was the conclusion reached by engineers of Cities Service Refining Corporation's Lake Charles refinery when they had to replace the caustic stripper in their Unisol unit. The stripper had originally been built using Monel® nickel-copper alloy claddings or linings comprising up to 20 per cent of the vessel wall thickness. That was when wartime restrictions had made it difficult to obtain sufficient quantities of the solid alloy.

When the decision came to replace it, the design was also revised as operating experience suggested.

Goes right back to Monel

This time Cities Service is using 7/16" solid Monel nickel-copper alloy.

They reason this way. Monel remains one of the most resistant of all materials to conditions encountered in caustic regeneration. The 7/16" wall can be expected to give years of trouble-free service. What's more, solid Monel is easy to fabricate. If repair is needed, a relatively simple welding job will handle it.

Cities Service is also using this nickel-copper alloy for hot caustic lines, heat exchangers and the internal reboiler tube bundle.

Caustic corrosion is seldom a clean cut problem with an easy answer...but nickel or nickel alloys like Monel will usually handle it. That's why Inco's Corrosion Engineering Section is one of the first places to go for advice and suggestions. So if you are having trouble, write today . . . giving full details.

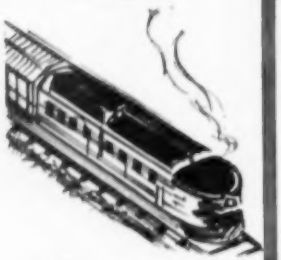
*Registered Trademark

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO 50 YEARS OF Nickel Alloy Progress PIONEERED BY MONEL 1905-1955

 (To obtain more data on advertised products see page 126)

reodorize petroleum malodors with Alamask!



Make olfactorily acceptable petroleum products!

Producers of petroleum products and of petro-chemicals – by adding a selected ALAMASK reodorant – can improve odor characteristics of such materials. A specific ALAMASK is available to achieve adequate reodorization of a variety of petroleum products.

FOR REODORIZATION OF:

FUEL OILS *(regular or premium gasoline blends)*
KEROSENE
DIESEL OILS
CUTTING OILS and SPECIALTIES
many other petroleum products

Gain olfactory relief with an ALAMASK.

Write, wire or phone for specific information. Our Engineering Section provides complete technical guidance.

Rhodia INC.
230 Park Avenue, New York 17, N. Y.
PLANT: PATERSON, N. J.

A NEW, EASY WAY TO ORDER REPRINTS

You can now use the Reader's Service Card in this issue of PETROLEUM PROCESSING to order reprints. Here's how:

- Check the list of reprints on page 128.
- Circle the proper "R" letter on the Reader's Service Card (Area "C").
- Fill in your name and address—and send the card to us.

We'll bill you with the reprints

Air Powered Floodlight

. . . **supplies 150 watts** of explosion-proof lighting where electric power is not available.

A compressed air turbo-generator, operating on a 60 to 100 psi air pressure, supplies current to a new 150-watt, 12-volt TGB 41 lamp. Constant speed is maintained by reducing valves, regardless of pressure variations. The 22-lb. semi-portable light uses 23 cubic feet of air per minute, and uses the exhaust air for cooling.

Full safety is ensured by an automatic turbine cutoff in case the blast-proof lens is shattered by a blow during operation. A filtering device prevents foreign matter from entering the turbo-generator through the air supply. **Copco Eastern Ltd.**, 250 Park Ave., New York, N. Y.

Circle No. **43** *on Reply Card*

Free Trade Literature

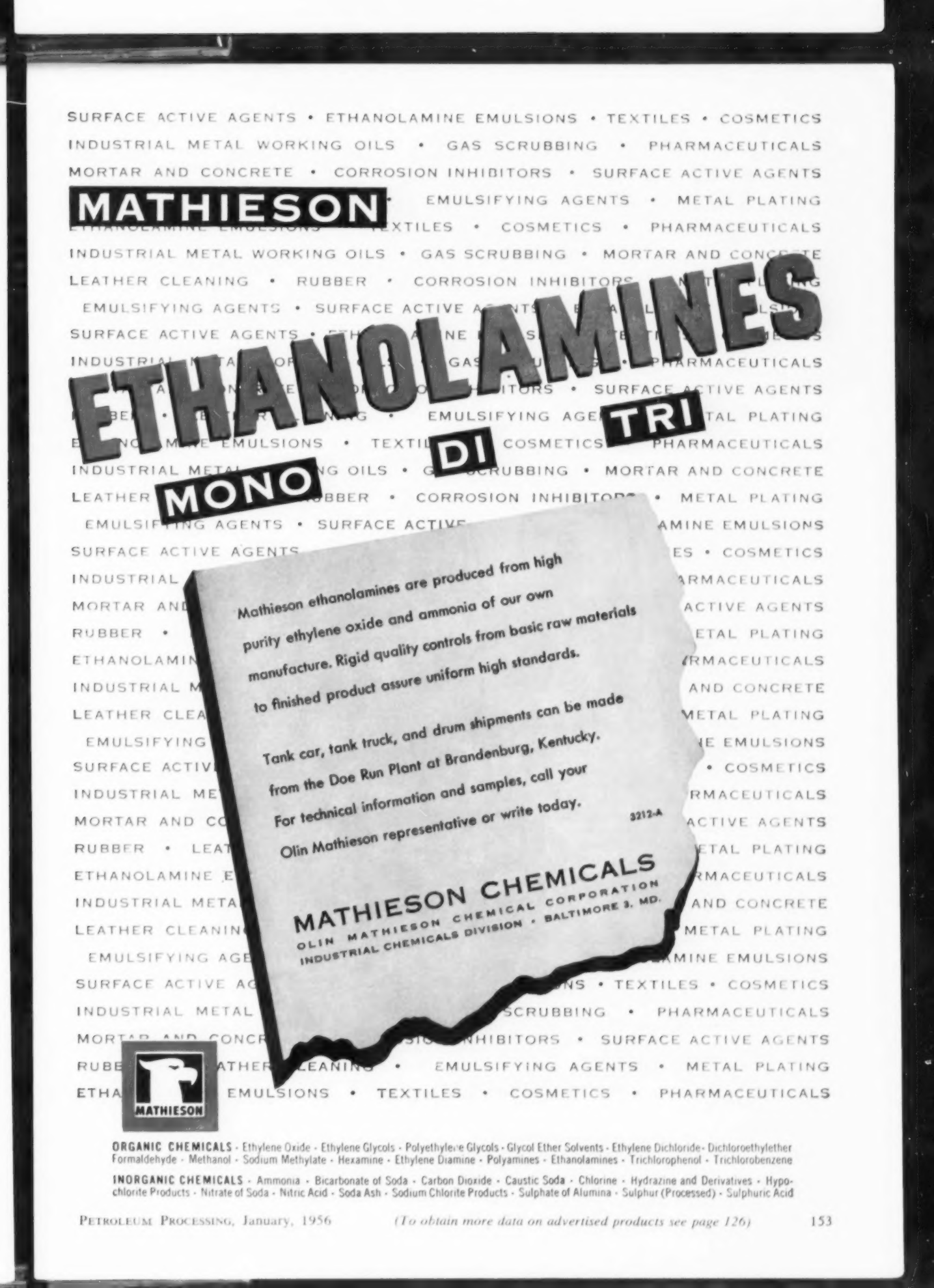
Petroleum Processing Index

. . . for 1955: including subject and author indexes for all feature articles and regular departments for the 12 issues of this magazine published during the past year. Available now from McGraw-Hill Petroleum Publications, 330 West 42nd St., New York 36, N. Y., or . . .

Circle No. **44** *on Reply Card*

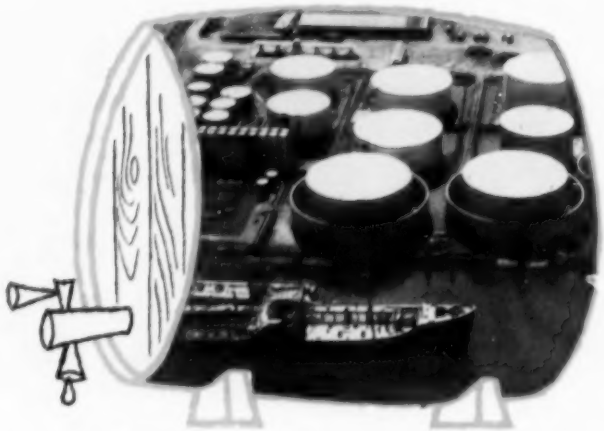
Centrifugal Pump

. . . of new, patented design: *Form 7335* describes a pump with a diverging type impeller having a much greater area at the discharge than at the inlet. This design enables the pump to handle liquids with high concentrations of solids, air, and gases. Capaci-

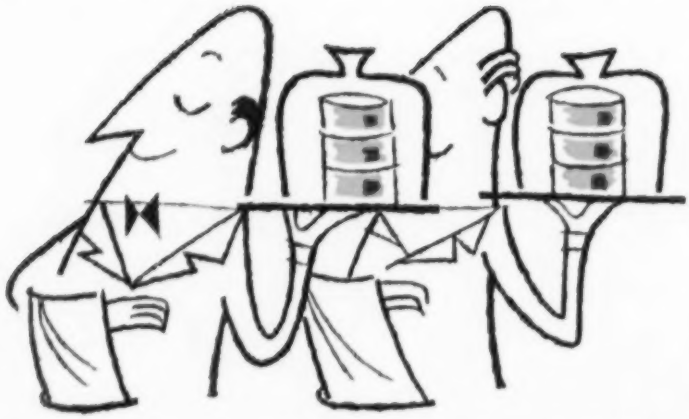

MATHIESON
ETHANOLAMINES
MONO
DI
TRI
Mathieson ethanolamines are produced from high purity ethylene oxide and ammonia of our own manufacture. Rigid quality controls from basic raw materials to finished product assure uniform high standards.
Tank car, tank truck, and drum shipments can be made from the Doe Run Plant at Brandenburg, Kentucky.
For technical information and samples, call your Olin Mathieson representative or write today.
3212-A
MATHIESON CHEMICALS
OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.
MATHIESON

ORGANIC CHEMICALS - Ethylene Oxide - Ethylene Glycols - Polyethylene Glycols - Glycol Ether Solvents - Ethylene Dichloride - Dichloroethylether Formaldehyde - Methanol - Sodium Methylate - Hexamine - Ethylene Diamine - Polyamines - Ethanolamines - Trichlorophenol - Trichlorobenzene

INORGANIC CHEMICALS - Ammonia - Bicarbonate of Soda - Carbon Dioxide - Caustic Soda - Chlorine - Hydrazine and Derivatives - Hypochlorite Products - Nitrate of Soda - Nitric Acid - Soda Ash - Sodium Chlorite Products - Sulphate of Alumina - Sulphur (Processed) - Sulphuric Acid



STORE IN BULK

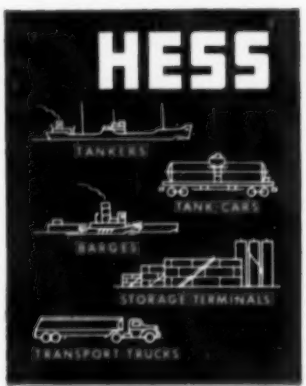


SHIP IN DRUMS

HESS integrated bulk liquid storage terminals in the New York Harbor and on the Gulf Coast are equipped with modern high-speed drumming and canning facilities to meet the needs of your customers or your own process operations.

Take advantage of low seasonal or quantity prices; ship by tanker, barge, tank car or transport truck; and store with complete confidence. Hess individual tanks can handle chemicals, petrochemicals, petroleum products, edibles and other bulk liquids in quantities from 10,000 to 10,000,000 gallons with complete privacy—receiving and shipping through separate piping and pumping facilities. All the benefits of your own storage plant can be yours without maintenance headaches or capital investment.

For the full story write for your copy of new illustrated book telling how your products will be handled and stored. Please address your inquiry to our location nearest you so that we can give it immediate attention.



HESS, INCORPORATED
Perth Amboy, N. J.
VAlley 6-1000
HESS TERMINAL CORP.
Houston, Texas
Glendale 37195

ties range from 200 to 7000 gpm and heads from 5 to 225 ft. Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Circle No. **45** *on Reply Card*

Telemetering

. . . and remote control: *Bulletin 230-H4A* describes the application of Chronoflo Meters in the remote metering of flow, level, pressure, and temperature; and the control of pumps, feeders, and valves over long distances. Builders-Providence, Inc., 345 Harris Ave., Providence, R. I.
Circle No. **46** *on Reply Card*

Ethylene Production

. . . via the steam pyrolysis process: new booklet describes, with flow charts and economic breakdown table, the advantages of this process for producing ethylene from a residual oil charge. Chemical Process Division, M. W. Kellogg Co., 225 Broadway, New York 7, N. Y.
Circle No. **47** *on Reply Card*

Foam Protective System

. . . at Celanese's new Newark, N.J., petrochemical terminal. Describes the "Aer-O-Foam 99" system and its piping arrangement to provide fire fighting protection around the storage and loading facilities. National Foam System, Inc., West Chester, Pa.
Circle No. **48** *on Reply Card*

Indirect Heater Manual

. . . tells how to size indirect heaters for oil and gas service. *Delta Indirect Heaters Sizing Manual* includes typical solutions to heater problems, along with working charts and nomographs. Delta Tank Manufacturing Co., Inc., Oil Equipment Division, Baton Rouge, La.
Circle No. **49** *on Reply Card*

Molybdenum

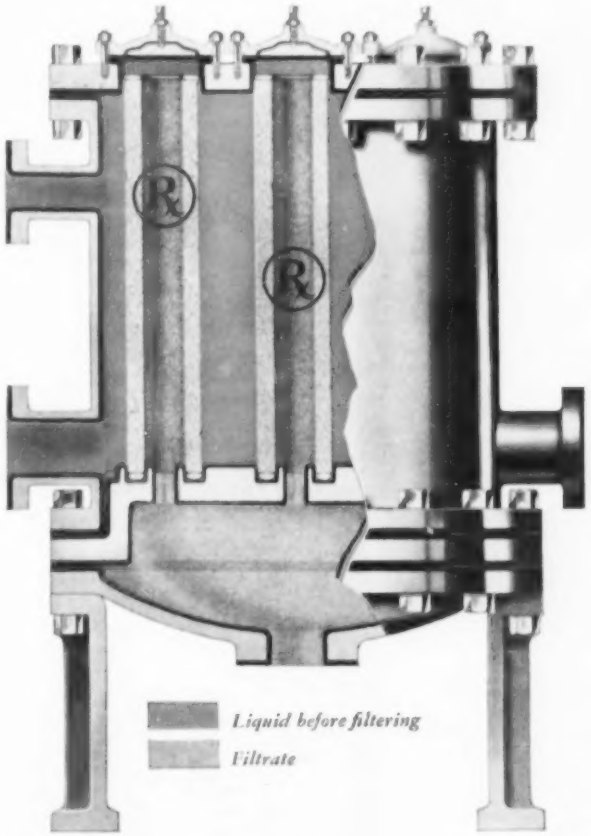
. . . and its compounds are discussed in *Bulletin Cdb-2*. Based on a comprehensive search of literature of the past 20 years, this bulletin is a collection of the thermodynamic values for molybdenum and its more important compounds. Climax Molybdenum Co., 500 Fifth Ave., New York 26, N. Y.
Circle No. **50** *on Reply Card*

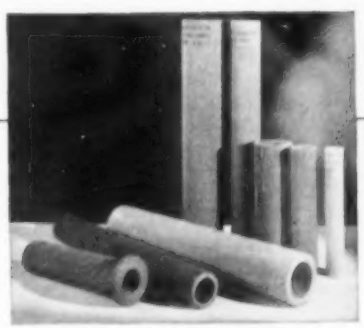
pH Control Handbook

. . . includes the theory and practice of colorimetric analysis. The pocket-size, 100-page booklet, *Modern pH*

Another Norton Rx *on the job!*

Outstanding performance of Adams filters aided by Norton seamless porous tubes





R. P. Adams Co. Filters, covering many chemical filtering services, deliver sparkling clear filtrate and insure quick cleaning without disassembly. Adams filters handling acid or neutral solutions are equipped with Norton seamless porous tubes, *engineered and prescribed* for faster, more thorough filtering and backwashing.

Besides assuring fast, thorough filtering action, Norton porous tubes are extremely easy to clean by backwashing. Here are several good reasons why they excel in these two primary essentials of efficient, economical filter performance:

- Norton porous tubes are made of ALUNDUM* (fused alumina) *engineered* by Norton for chemical stability, inertness and other properties necessary to withstand acid, neutral and slightly alkaline liquors.
- Like all Norton ALUNDUM porous mediums they are made with the patented *controlled structure* process that assures even distribution of pores — for uniform passage of both filtering and backwashing liquids.
- They are *seamless,* providing unobstructed diffusion over their entire area — for further efficiency in both filtering and cleaning.

Other big advantages

of all Norton porous mediums include ease of installation and exceptional resistance to breakage and chipping. Available in sizes and open-pore ratios to meet your needs, they're *engineered* to last longer and cut your operating costs — and they're *prescribed* for a wide variety of chemical services, such as filtering water or solvents . . . cutting oils, wine, etc. . . . reclaiming cleaning fluids and industrial waste . . . and for boiler feed water treatment, carbonation, chlorination and other gas diffusion applications.

See your Norton Representative for further facts or write, describing your requirements, to NORTON COMPANY, 260 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

NORTON

REFRACTORIES

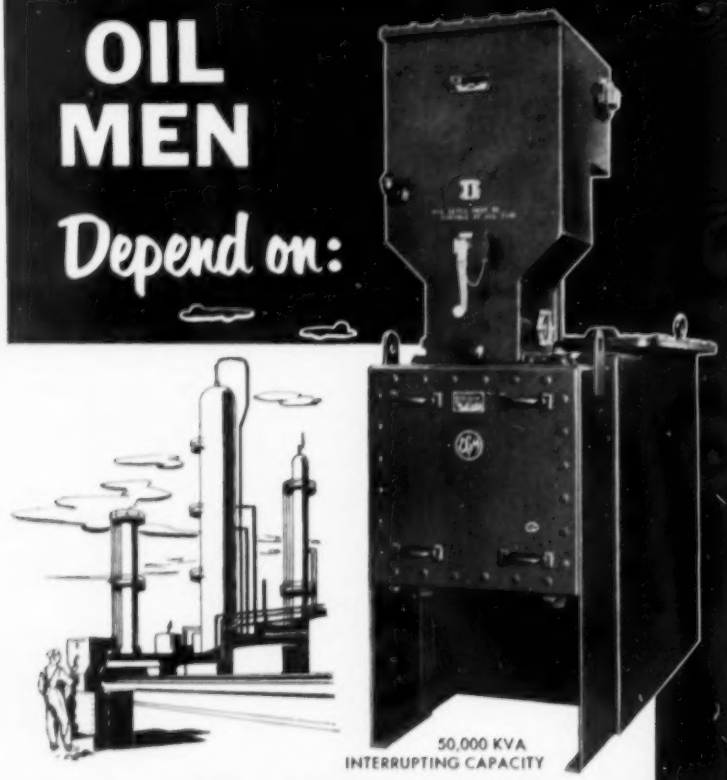
Engineered . . . Rx . . . Prescribed

Making better products . . . to make other products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

(To obtain more data on advertised products see page 126)

OIL MEN Depend on:



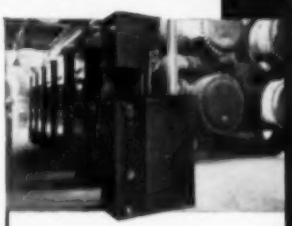
50,000 KVA
INTERRUPTING CAPACITY

EC&M 2200-5000 VOLT Motor Starters

These EC&M Div. 1 combination Starters for Class I, Group D locations give refinery engineers and construction and design companies top value. They require less floor space . . . line, motor and control leads are brought to conduit connection box for quick installation . . . and high interrupting capacity is inherent . . . 50,000 KVA, and no fuses required.

Oil disconnect switch (on top) may be locked open or closed . . . view windows on both sides show switch contacts. Rear oil-tank has potential transformer for 220-volt push button circuit. Type ZHS (50,000 KVA) Magnetic Contactor may be raised above oil for inspection without disconnecting any bolts or leads.

Before buying, investigate EC&M Combination Starters . . . they provide economy in installation, operation and maintenance . . . and they're complete in every respect.



ADVANTAGES of this Battery of EC&M Starters in a refinery.

1. Combination Starter with self-contained Oil Disconnect Switch
2. All internal wiring complete . . . leads brought to conduit box for easy connection to power and motor leads
3. Heavy duty contactor has alloy contacts
4. Slender design reduces floor space
5. Thermal-Magnetic Overload Relays give accurate motor protection . . . trip instantly on faults
6. Simple 3-wire time-delay UVP push button circuit

Write for descriptive Booklet 1062-VIII

THE ELECTRIC CONTROLLER & MFG. CO.

4498 LEE ROAD • CLEVELAND 28, OHIO

and Chlorine Control, is a handy reference for quantitative determinations of pH, chlorine, bromine, phosphate, nitrate, sulfite, hardness, and other special tests. Slide comparators and complete test kits are illustrated. W. A. Taylor Co., 7300 York Rd., Baltimore 4, Md.

Circle No. **51** *on Reply Card*

Naphtha Reforming

. . . using Sinclair-Baker platinum catalyst RD-150 for the production of high octane reformates: new booklet, *Low Cost Production of 95 Octane Clear Reformate*, describes in detail the naphtha reforming process developed by M. W. Kellogg Co. Flow charts outline the process that permits effective desulphurization of low-grade naphthas. M. W. Kellogg Co., 225 Broadway, New York, N. Y.

Circle No. **52** *on Reply Card*

Chlorinated Organics

. . . is the subject of a new 48-page book of the same title. Included is a discussion of 18 products, their solvent properties, and how to handle and store them. Important data on physical properties of these chlorinated compounds are furnished in chart form. Also included is a list of references giving additional source material. Carbide and Carbon Chemicals Co., 30 East 42nd St., New York 17, N. Y.

Circle No. **53** *on Reply Card*

Compressors

. . . single-stage horizontal type, are discussed in *Bulletin No. L-640-BIC*. Information is presented on basic specifications, standard equipment, running gear parts, capacity control, cylinder construction, feather valves, and special applications. Various diagrams, cutaways, and photographs of actual installations are included with a general data chart. Worthington Corp., Harrison, N. J.

Circle No. **54** *on Reply Card*

Temperature Controls

. . . actuated by the variation in the expansion of two different solids: *Catalog G-20* describes the complete line of instruments using this principle for temperature regulation Adaptable to electric or pneumatic systems, these controls can be used for temperatures of sub-zero to 1800° F., with accuracies from ± ¼° F. to ± 25° F. Burling Instrument Co., 16 River Rd., Chatham, N. J.

Circle No. **55** *on Reply Card*

top Cat on cracking efficiency!

Aerocat Triple A*

high alumina catalyst

balanced with HI PV*

Both high pore volume and high alumina content—that's what AEROCAT TRIPLE A High Alumina Catalyst offers refiners. This combination boosts cracking efficiency through

higher initial activity
higher thermal and steam stability
lower stack losses
excellent selectivity

In AEROCAT TRIPLE A High Alumina Catalyst, Cyanamid has carefully balanced high pore volume with pore diameter and specific surface. The result is higher activity maintenance than is possible with low pore diameter high alumina catalysts.

AEROCAT TRIPLE A is the product of a 7-year research program at Cyanamid. Commercial experience in 24 units has yielded precise determinations of its cracking efficiency and product distribution in equilibrium. It's a proved and tested catalyst!

Your Cyanamid representative will be glad to tell you what AEROCAT TRIPLE A High Alumina Catalyst with HI PV can do for your operation. Call him today.

*Trade mark

AMERICAN Cyanamid COMPANY
REFINERY CHEMICALS DEPARTMENT
30 Rockefeller Plaza • New York 20, N.Y.
In Canada: North American Cyanamid Limited, Toronto and Montreal

The National Merit Scholarship Corporation

Business is Offered Big Dividends on Investment in Higher Education

The McGraw-Hill Publishing Company is availing itself of the opportunity to establish ten National Merit Scholarships. They will be known as the McGraw-Hill Merit Scholarships. The scholarships are to be awarded to qualified candidates for a four-year college course in the fields of science, engineering and the other professions and the liberal arts. There will be no limitation, beyond the appropriate professional accrediting, on the college or university selected by a successful candidate. As part of a continuing program to aid higher education and educational institutions, McGraw-Hill is happy to be able to share in what it believes to be the constructive educational endeavor of the National Merit Scholarship Corporation.

Business firms searching for a satisfactory avenue to provide financial aid for our colleges and universities now have a new opportunity of major importance. It is provided by the National Merit Scholarship Corporation, which has offered to devote $8 million to matching, dollar for dollar, gifts by business firms for college scholarships and supplemental gifts to the institutions where the scholarships are used.

The National Merit Scholarship Corporation, an independent agency financed initially by gifts of $20 million from the Ford Foundation and $500,000 from the Carnegie Corporation, has three major purposes which are closely related. They are:

1. To locate those of the nation's young men and young women who are best equipped to go to college.

2. When necessary, to help these young people go to college by giving them financial aid.

3. To help colleges and universities meet the full cost of the instruction of those to whom National Merit scholarships are granted.

At present about half of the nation's top high school graduates do not go to college. The principal reason is that they do not have the money required.

To Save Unused Brain Power

The National Merit Scholarship Corporation will strive to eliminate this dangerous neglect of top-flight ability. To this end it is inviting the nation's high schools, numbering more than 24,000, to participate in its program by designating as available candidates for National Merit scholarships the top 5 percent of their senior classes. Those so designated are then invited to take a series of tests and to submit reports designed to assure selection of the very best talent in each state. The number of scholarships to be allotted to each state will be proportionate to the number of high school graduates in the state.

The winners, the total number of whom will be determined by the amount of money the Scholarship Corporation has available, will be eligible for awards. For those who need no financial help to go to college there will be honorary awards of $100. For those who must have help the Corporation will grant scholarships covering as much as necessary

of the cost of instruction and living expenses for a four-year college course.

Colleges Get Financial Help

The provision of funds to cover the students' expenses does not, however, solve the financial problems faced by many colleges. That is because the tuition charges paid by the students do not cover the cost of the instruction. The deficit must be met by drawing upon endowment funds, gifts, grants, and other available sources.

Consequently, to prevent holders of National Merit scholarships from imposing any additional financial burden on the colleges and universities they elect to attend, the Corporation will make a supplementary grant to these institutions. The supplementary grant will be the equivalent of regular tuition charges made by the school, with a top limit of $1,500 a year for both the tuition and the supplement.

As the scholarship grants to the winning students will vary, depending upon how much financial help they need, so will the supplementary grants vary from one college to another, depending on their regular tuition charges. However, it is anticipated that on the average the full cost of a National Merit scholarship—including aid to the student and the supplement to the college—will be about $1,500 a year.

Many business firms will find a compelling appeal in a program which is designed at once to mobilize the nation's intellectual resources more effectively and, in the process, give very badly needed financial help to our colleges and universities.

Two For One Return Offered

However, there are numerous other inducements to business firms to finance National Merit scholarships. These scholarships may:

1. Carry the name of the firm or be named in honor of someone designated by the firm.
2. Be limited to use in types of colleges of particular interest to the sponsoring firm.
3. Be limited to a college course, such as science, engineering or liberal arts, of special concern to the sponsor.
4. Be restricted to candidates or institutions in geographic areas specified by the sponsor.

In addition to these advantages there is a special financial inducement to help the Merit Scholarship program. It is that for every Merit scholarship a firm or individual finances, the Corporation will, up to the limit of $8 million, match the funds and make another National Merit scholarship available.

There are many good ways of helping our financially beleaguered colleges and universities, and many corporations are already using one or more of them.* For those companies that can do so without embarrassing complications one of the best ways is to make unrestricted gifts directly to the institutions. But this new way provided by the creation of the National Merit Scholarship Corporation (Address: 1580 Sherman Avenue, Evanston, Illinois) has the broad appeal of serving two purposes of transcendent importance simultaneously. The purposes are to see that our best brains are fully trained and utilized and that our colleges and universities, crucial contributors to this process, are helped at the same time. Business will serve the nation and its own community well by giving the National Merit Scholarship Corporation generous help.

---

* These, as well as the plight of our colleges and universities, are discussed in a pamphlet, "Business Aid to Our Colleges and Universities," which embodies a series of five editorials which appeared in all McGraw-Hill publications. Copies of the pamphlet can be obtained without charge by addressing the Department of Economics, McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York 36, New York.

Methods of helping our colleges and universities financially are also outlined and discussed in a pamphlet, "Aids to Corporate Support of Higher Education," which may be obtained without cost by addressing the Council for Financial Aid to Education, 6 East 45th Street, New York 17, New York.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

EDITORIALS . . .

That Guy Has His Nerve

LAST month, O. A. Knight of the Oil, Chemical and Atomic Workers, announced that his members could justify an immediate wage raise of 32¢ an hour. His prime reason was increased productivity.

He stated that "in the last year, productivity increased 13% measured by the most conservative possible yardstick—increase in refinery input per day of labor employed. So just in one year we can justify a 13% increase, or about 32¢ an hour."

We don't doubt the 13% increase in refinery input last year per day of labor employed.

But we think every last engineer and scientist in any way connected with a refinery should highly resent Knight's usurping for his union members all the credit for that increased productivity.

Doesn't Knight know—or does he choose to ignore—the fact that during a single year refiners in the U.S. spend about a billion dollars for the design and building of new and improved plants?

Doesn't he know that at least another $200-million is spent each year on research—to develop new processes, and improve existing ones.

Doesn't he know about the millions of man-days of engineering talent poured into the industry's processing facilities each year?

Doesn't he know that the plants and processes are more efficient as a result of all these efforts—and hence more "productive"?

We're astounded at the colossal gall of the fellow in trying to take for his members all the credit for these improvements.

We know where the bulk of the credit belongs—and we suspect Knight does, too. It's with the tens of thousands of technologists who are constantly working out better processes and better equipment for the plants. It's with the managers who have enough faith in their technologists to go ahead and invest the money needed to put these improved tools to work.

And we might even suggest that this magazine deserves some of the credit for making available to everyone in the industry ideas on how to do a better job—on how to be more "productive."

Why He Won't Study Science

THE assistant superintendent of Oklahoma City's schools has made a survey to find out what high school students think about the idea of becoming scientists. He asked 100 high school juniors "Why is it more students do not take science and math?" The majority described the courses as dull, and said they aren't taught to really "understand" the subjects. They described scientists as "squares," "little old men with beards working in a musty laboratory," and "an evil genius on TV thinking up ways to torture people."

Maybe we need more than programs for improving the teachers, such as the Shell plan outlined on this page last month. Maybe we need a little more basic education of our youngsters to dispel a few myths.

Sparks in the Fuel Oil Picture

ASK almost any oil man today what he would say is the most expensive way to heat your home and chances are his answer would be "Use electricity."

We'll have to admit an oil man might be prejudiced. But he's on fairly firm ground. Electricity is expensive for such a job. Its large scale use for heating has been practical only in regions that enjoy low electric rates, such as the TVA area.

However, as brought out elsewhere in this issue (pg. 15), a new factor is entering the picture—air conditioning. At first thought you might wonder how air conditioning can possibly affect the competitive picture between oil and electricity.

Here's how. Air conditioning is a summer item. The units are large users of electricity. As a result, the electric companies are finding themselves with a growing demand during the summer—and are having to put in new generating capacity to meet it. But they have no such demand in winter.

About the only big winter load they can go after seems to be for home heating. And the way they go after such a market is to lower rates. In Tulsa, for example, the power company has such an unbalanced load as a result of summer air-conditioning demands that it wants to drop its heating rate from 2.5¢ to 1.1¢ per Kwh in an effort to equalize demand.

Even that large a drop in rates may not bring electricity in Tulsa down to the level of other energy sources—but strong promotion by the power company and rising costs for oil and gas could quickly wipe out the difference.

"What has all that got to do with me?" you ask. "I'm only the fellow who designs or builds or runs the refineries that turn out the fuel oil. Selling the stuff is Marketing's baby."

So it is. But if Marketing can't sell it, you won't have to design or build new plants to make it—or run the existing plants. You've got a stake in this business, too. And your part consists of designing more effective plants, or building them less expensively, or operating them more efficiently.

So don't be too complacent in the thought that fuel oil is here to stay. It's here only as long as it's competitive—and keeping it competitive by keeping its cost down is your job.

VERSATILE Boron Trifluoride has rung the bell as a catalyst so many times . . . has "carried through" so many different organic syntheses . . . that some chemical engineers are beginning to think of BF_3 as almost universal in its applications.

THE NEXT synthesis problem it will help solve may well be *yours*. Write today for more detailed information on the properties and some of the uses of Baker & Adamson Boron Trifluoride and its complexes.

For

Polymerization
Alkylation
Esterification
Acylation
And Many Other Reactions

FINE CHEMICALS
B·A
REAGENTS

BAKER & ADAMSON® *Fine Chemicals*
GENERAL CHEMICAL DIVISION, ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Please send me further information on Boron Trifluoride

☐ I would like general information on the properties and uses of Boron Trifluoride

☐ I would like specialized information on Boron Trifluoride for the following use:

Name

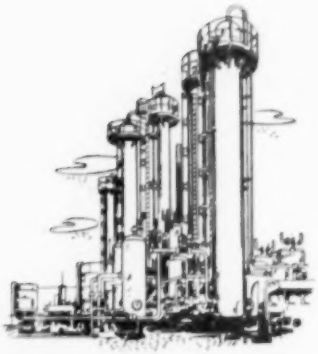
Company

Address

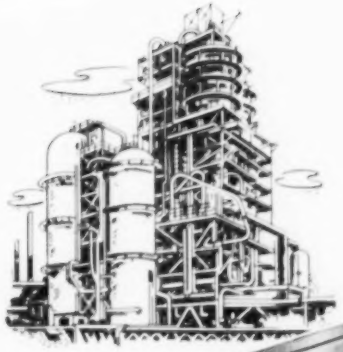
City Zone State

FP-1

Wyatt's ... Facilities are Equal to whatever the Processing Industries require



• This record rail load for length, 192 feet, was Fabricated in Wyatt's Houston Plant for Oil Refining Service on the Gulf Coast



Wyatt's
HOUSTON · DALLAS · NEW YORK · TULSA

MANUFACTURERS AND ERECTORS SINCE 1913